

## Lampiran 1 : Prosedur Perhitungan Durasi

**Begin**

```

for i=0 to m
  tnow=0;
  sum=0;
  penuhi=0;
  pendahulu=0;
  for j=0 to naktivitas-1
    aktivitasj = j+1;
    finishedj = 0;
    stj = 0;
    ftj = 0;
  end
  do
    for j=0 to naktivitas-1
      if ( aktivitasj !=0)
        if ( pendahuluj,0==0)
          for k=0 to ntipe-1
            if ( sumberdayak >= kebutuhanj,k)
              eligiblej = fireflyi,j;
              elj = 1;
            end
          else
            eligiblej = 0;
            elj = 0;
          end
        end
      end
      else
        for k=0 to ntipe-1
          if (pendahuluj,k !=0)
            pendahulu = pendahulu + 1;
            for l=0 to naktivitas
              if (pendahuluaj,k == finishedl)
                sum = sum + 1;
              end
            else
              sum = sum + 0;
            end
          end
        end
        else
          pendahulu = pendahulu + 0;
          sum = sum + 0;
        end
      end
    end

    if (penuhi == ntipe)
      eligiblej = fireflyi,j;
      elj = 1;
    end
    else
      eligiblej = 0;
    end
  end

```

```

        e1j=0;
    end
   penuhi=0;
end
else
    eligiblej=0;
    e1j=0;
end
end
else
    eligiblej=0;
    e1j=0;
end
sum=0;
pendahulu=0;
end
for m=0 to naktivitas-1
    sum1=sum1+e1m;
end
if (sum1!=0)
    jadwal=0;
    jadwalkan=0;
    for n=0 to naktivitas-1
        if (jadwal<eligiblen)
            jadwal=eligiblen;
            jadwalkan=n;
        end
    end
    stjadwalkan = tnow;
    ftjadwalkan = tnow + durasijadwalkan,1;
    aktivitasjadwalkan = 0;
    for n=0 to ntipe-1
        sumberdayan=sumberdayan - kebutuhanjadwalkan,n;
    end
end
else
    tercepat=1000;
    for n=0 to naktivitas-1
        if (ftn>tnow && ftn<=tercepat)
            tercepat = finishedn;
        end
    end
    for m=0 to naktivitas
        if (ftm==tercepat)
            finishedm=m+1;
            for o=0 to ntipe-1
                sumberdayao=sumberdayao + kebutuhanjadwalkan,n;
            end
        end
    end
end
tnow=tercepat;
sum1=0;
prejadwal=0;
for j=0 to naktivitas

```

```
        prejadwal=prejadwal+aktivitas;  
    end  
end  
while (prejadwal !=0)  
    durasi=0;  
    for j=0 to naktivitas  
        if ( ftj> durasi)  
            durasi=ftj;  
        end  
    end  
end  
end  
end
```

**Lampiran 2 : Data Proyek Dengan 25 Aktivitas**

Aktivitas	Durasi	R1	R2	R3	P1	P2	P3
1	5	5	3	2	0	0	0
2	5	4	5	3	0	0	0
3	3	2	5	2	0	0	0
4	4	1	4	4	1	2	0
5	2	4	2	4	1	2	0
6	1	5	5	4	3	0	0
7	6	5	3	2	3	0	0
8	6	2	3	2	4	5	7
9	1	1	4	4	4	0	0
10	3	2	3	4	5	6	7
11	3	3	3	2	6	0	0
12	3	4	2	4	8	10	0
13	3	5	5	4	8	0	0
14	6	2	2	2	9	0	0
15	6	5	1	4	11	0	0
16	3	3	5	3	12	0	0
17	3	2	3	3	14	0	0
18	4	5	4	4	13	15	0
19	1	4	2	6	15	0	0
20	4	0	1	4	16	0	0
21	4	6	1	2	16	17	0
22	1	2	2	1	18	0	0
23	6	2	3	1	18	19	0
24	3	2	2	2	20	0	0
25	3	1	0	3	20	21	22

Sumber daya yang tersedia :

R1	R2	R3
6	6	6

**Lampiran 3 : Data Proyek Dengan 60 Aktivitas**

aktivitas	durasi	R1	R2	R3	R4	Pendahulu1	Pendahulu2	Pendahulu 3
	8	10	0	0	0	0	0	0
2	1	0	1	0	0	0	0	0
3	10	0	9	0	0	0	0	0
4	6	0	4	0	0	1	0	0
5	5	0	0	0	1	4	0	0
6	8	10	0	0	0	2	0	0
7	9	0	0	6	0	3	0	0
8	1	0	0	0	8	7	0	0
9	9	0	6	0	0	1	0	0
10	8	0	0	0	3	9	0	0
11	3	0	7	0	0	3	0	0
12	6	8	0	0	0	8	0	0
13	2	0	0	0	1	2	0	0
14	5	0	0	0	9	1	0	0
15	1	6	0	0	0	3	0	0
16	3	2	0	0	0	5	0	0
17	10	0	0	2	0	12	13	0
18	9	7	0	0	0	13	0	0
19	1	5	0	0	0	7	0	0
20	3	0	0	8	0	11	0	0
21	6	0	4	0	0	4	0	0
22	3	0	0	4	0	6	0	0
23	3	0	5	0	0	4	0	0
24	7	0	0	1	0	14	0	0
25	6	9	0	0	0	10	0	0
26	20	0	7	0	0	11	19	0
27	9	3	0	0	0	17	18	0
28	8	0	0	3	0	2	0	0
29	4	0	0	7	0	26	0	0
30	3	6	0	0	0	19	21	0
31	3	0	0	0	4	16	0	0
32	6	0	7	0	0	17	0	0
33	1	0	0	0	4	13	0	0
34	9	0	0	1	0	8	0	0
35	9	9	0	0	0	34	0	0
36	1	0	7	0	0	10	0	0
37	2	5	0	0	0	5	0	0
38	4	0	0	1	0	20	32	34
39	9	0	0	0	5	7	24	0
40	10	0	0	0	1	28	0	0
41	8	0	0	0	9	35	0	0
42	4	0	0	6	0	16	30	0

aktivitas	durasi	R1	R2	R3	R4	Pendahulu1	Pendahulu2	Pendahulu 3
43	3	0	0	0	1	10	33	0
44	6	0	0	0	7	9	0	0
45	6	0	0	0	0	40	0	0
46	7	4	0	0	0	27	0	0
47	3	0	8	0	0	23	41	0
48	2	0	2	0	0	25	0	0
49	10	0	0	7	0	37	43	0
50	4	0	5	0	0	22	26	42
51	2	2	0	0	0	46	0	0
52	1	0	1	0	0	38	39	44
53	4	0	0	6	0	25	51	0
54	10	0	0	0	7	15	47	53
55	8	0	0	3	0	29	45	52
56	6	0	4	0	0	28	31	54
57	10	0	0	9	0	15	36	42
58	3	0	0	0	7	14	56	57
59	10	0	3	0	0	37	48	50
60	1	0	0	0	1	27	49	55

Sumber daya yang tersedia

R1	R2	R3	R4
13	11	12	13

## Lampiran 4 Source Code Program

```

#include <iostream>
#include <conio.h>
#include <fstream>
#include <stdlib.h>
#include <time.h>
#include <math.h>
#include <io manip.h>

//-----load data RPCSP disini-----//
//-----input data durasi-----//
int durasi1[10]={9,5,9,10,8,1,10,6,3,9};
int durasi2[25]={5,5,3,4,2,1,6,6,1,3,3,3,3,6,6,3,3,4,1,4,4,1,6,3,3};
int durasi3[60]={8,1,10,6,5,8,9,1,9,8,3,6,2,5,1,3,10,9,1,3,6,3,3,7,6,20,9,8,4,3,3,6,1,9,9,1,
                2,4,9,10,8,4,3,6,6,7,3,2,10,4,2,1,4,10,8,6,10,3,10,1};

//-----input data persediaan sumber daya-----//
int persediaan1[4]={20,19,23,23};
int persediaan2[3]={6,6,6};
int persediaan3[4]={13,11,12,13};

//-----input data kebutuhan sumber daya-----//
int kebutuhansdaya1[10][4]={{3,7,0,10},{0,2,10,6},{7,5,7,0},{4,6,10,8},{8,4,7,8},
                             {9,7,1,3},{3,0,2,4},{4,0,3,8},{0,7,4,0},{4,0,4,8}};
int kebutuhansdaya2[25][3]={{5,3,2},{4,5,3},{2,5,2},{1,4,4},{4,2,4},{5,5,4},{5,3,2},
                             {2,3,2},{1,4,4},{2,3,4},{3,3,2},{4,2,4},{5,5,4},{2,2,2},{1,4},{3,
                             5,3},{2,3,3},{5,4,4},{4,2,6},{0,1,4},{6,1,2},{2,2,1},{2,3,1},{2,2
                             ,2},{1,0,3}};
int kebutuhansdaya3[60][4]={{10,0,0,0},{0,1,0,0},{0,9,0,0},{0,4,0,0},{0,0,0,1},{10,0,
                             0,0},{0,0,6,0},{0,0,0,8},{0,6,0,0},{0,0,0,3},{0,7,0,0},{8,0,0,0},
                             {0,0,0,1},{0,0,0,9},{6,0,0,0},{2,0,0,0},{0,0,2,0},{7,0,0,0},{5,0,
                             0,0},{0,0,8,0},{0,4,0,0},{0,0,4,0},{0,5,0,0},{0,0,1,0},{9,0,0,0},
                             {0,7,0,0},{3,0,0,0},{0,0,3,0},{0,0,7,0},{6,0,0,0},{0,0,0,4},{0,7,
                             0,0},{0,0,0,4},{0,0,1,0},{9,0,0,0},{0,7,0,0},{5,0,0,0},{0,0,1,0},
                             {0,0,0,5},{0,0,0,1},{0,0,0,9},{0,0,6,0},{0,0,0,1},{0,0,0,7},{0,0,
                             0,0},{4,0,0,0},{0,8,0,0},{0,2,0,0},{0,0,7,0},{0,5,0,0},{2,0,0,0},
                             {0,1,0,0},{0,0,6,0},{0,0,0,7},{0,0,3,0},{0,4,0,0},{0,0,9,0},{0,0,
                             0,7},{0,3,0,0},{0,0,0,1}};

//-----input data pendahulu aktivitas-----//
int pendahulu1[10][4]={{0,0,0,0},{0,0,0,0},{0,0,0,0},{1,0,0,0},{3,0,0,0},{2,0,0,0},
                       {5,0,0,0},{3,0,0,0},{1,0,0,0},{1,0,0,0}};
int pendahulu2[25][4]={{0,0,0,0},{0,0,0,0},{0,0,0,0},{1,2,0,0},{1,2,0,0},{3,0,0,0},
                       {3,0,0,0},{4,5,7,0},{4,0,0,0},{5,6,7,0},{6,0,0,0},{8,10,0,0},
                       {8,0,0,0},{9,0,0,0},{11,0,0,0},{12,0,0,0},{14,0,0,0},{13,15,0,0},{15,0,
                       0,0},{16,0,0,0},{16,17,0,0},{18,0,0,0},{18,19,0,0},
                       {20,0,0,0},{20,21,22,23}};
int pendahulu3[60][4]={{0,0,0,0},{0,0,0,0},{0,0,0,0},{1,0,0,0},{4,0,0,0},{2,0,0,0},
                       {3,0,0,0},{7,0,0,0},{1,0,0,0},{9,0,0,0},{3,0,0,0},{8,0,0,0},{2,0,0,0},{
                       1,0,0,0},{3,0,0,0},{5,0,0,0},{12,13,0,0},{13,0,0,0},{7,0,
                       0,0},{11,0,0,0},{4,0,0,0},{6,0,0,0},{4,0,0,0},{14,0,0,0},{10,0,
                       0,0},{11,19,0,0},{17,18,0,0},{2,0,0,0},{26,0,0,0},{19,21,0,0},
                       {16,0,0,0},{17,0,0,0},{13,0,0,0},{8,0,0,0},{34,0,0,0},{10,0,0,0},
                       {5,0,0,0},{20,32,34,0},{7,24,0,0},{28,0,0,0},{35,0,0,0},{16,30,0,0},{

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```

10,33,0,0},{9,0,0,0},{40,0,0,0},{27,0,0,0},{23,41,0,0},
{25,0,0,0},{37,43,0,0},{22,26,42,0},{46,0,0,0},{38,39,44,0},{25,51,0
,0},{15,47,53,0},{29,45,52,0},{28,31,54,0},{15,36,42},
{14,56,57,0},{37,48,50,0},{27,49,55,0}};
//-----//
int pendahulu[100][100];
int durasi[100],naktivitas,ntipe,npendahulu;
int sumberdaya[100];
int kebutuhan[100][100],jadwaljadi[1000][100],jumlahjadwalkan;
//-----deklarasi variabel dan parameter hitung durasi//-----

int kegiatan[100],selesai,terjadwal[1000][100];
int finished[100],jadwalkan,indeks;
int st[100],ft[100],banyak,penuhi,prejadwal;
float E[100],sum1,E1[100],jadwal,intensitascahaya[1000],x[1000],bestiterasi[1000];
float
firefly[1000][100],best,terbaik[1000][100],bobot[1000],durasif[1000],solusi,Matriks[1][1000];
int tnow,sum,tercepat,r,s,ab,sda[100],v,dur,m,ftsem[1000][100],stsem[1000][100];
//-----//

void tampilkan durasi()
{
    int b;
    for(int y=0;y<=m-1;y++)
    {
        b=y+1;
        cout<<"durasi firefly ke- : "<<b<<endl;

        cout<<x[y]<<endl<<endl;
    }
}

void hitungintensitas(int i)
{
    intensitascahaya[i]=1/x[i];
}

void hitungdurasi(int i)
{
    tnow=0;
    sum=0;
    banyak=0;
    tercepat=0;
    penuh=0;
    sum1=0;
    prejadwal=0;
    jumlahjadwalkan=0;

    for(int j=0;j<=naktivitas-1;j++)
    {
        kegiatan[j]=j+1;//kegiatan yang belum dijadwalkan
        finished[j]=0;//list kegiatan yang terselesaikan
    }
}

```



```

st[j]=0;//list start time masing-masing aktivitas
ft[j]=0;//list finish time masing-masing aktivitas
E[j]=0;
E1[j]=0;
}

//copyarray

for(int g=0;g<=naktivitas-1;g++)
{
Matriks[0][g]=firefly[i][g];
}

for(int o=0;o<=ntipe-1;o++)
{
sumberdaya[o]=sda[o];
}

for(int h=0;h<=5*naktivitas-1;h++)
{
for(int k=0;k<=naktivitas-1;k++)
{
if(kegiatan[k]!=0)
{
if(pendahulu[k][0]==0)
{
for(int f=0;f<=ntipe-1;f++)
{
if(sumberdaya[f]>=kebutuhan[k][f])
{
penuhi=penuhi+1;
}
}
else
{
penuhi=penuhi+0;
}
}
}

if(penuhi==ntipe)
{
E[k]=Matriks[0][k];
E1[k]=1;
}
else
{
E[k]=0;
E1[k]=0;
}
penuhi=0;
}
else
{
for(int g=0;g<=npendahulu-1;g++)

```

```

{
    if(pendahulu[k][g]!=0)
    {
        banyak=banyak+1;
        for(int q=0;q<=naktivitas-1;q++)
        {
            if(pendahulu[k][g]==finished[q])
            {
                sum=sum+1;
            }
            else
            {
                sum=sum+0;
            }
        }
    }
    else
    {
        banyak=banyak+0;
    }
}
if(banyak==sum)
{
    for(int f=0;f<=ntipe-1;f++)
    {
        if(sumberdaya[f]>=kebutuhan[k][f])
        {
            penuhi=penuhi+1;
        }
        else
        {
            penuhi=penuhi+0;
        }
    }
    if(penuhi==ntipe)
    {
        E[k]=Matriks[0][k];
        E1[k]=1;
    }
    else
    {
        E[k]=0;
        E1[k]=0;
    }
    penuhi=0;
    banyak=0;
}
else
{
    E[k]=0;
    E1[k]=0;
}
}
}
else

```

```

{
    E[k]=0;
    E1[k]=0;
}
banyak=0;
sum=0;
}

for(int w=0; w<=naktivitas-1;w++)
{
    sum1=sum1+E1[w];
}

if(sum1!=0)
{
    jadwal=0;
    jadwalkan=0;
    for(int c=0;c<=naktivitas-1;c++)
    {
        if(E[c]>jadwal)
        {
            jadwal=E[c];
            jadwalkan=c;
        }
    }
    jadwaljadw[i][jumlahjadwalkan]=jadwalkan+1;
    jumlahjadwalkan++;
    st[jadwalkan]=tnow;
    ft[jadwalkan]=tnow+durasif[jadwalkan];
    stsem[i][jadwalkan]=tnow;
    ftsem[i][jadwalkan]=tnow+durasif[jadwalkan];

    kegiatan[jadwalkan]=0;

    for(int v=0;v<=ntipe-1;v++)
    {
        sumberdaya[v]=sumberdaya[v]-kebutuhan[jadwalkan][v];
    }
}

else
{
    tercepat=1000;

    for(int s=0;s<=naktivitas-1;s++)
    {
        if(ft[s]>tnow&&ft[s]<tercepat)
        {
            tercepat=ft[s];
        }
    }

    for(int s=0;s<naktivitas-1;s++)
    {
        if(ft[s]==tercepat)

```

```

    {
        finished[s]=s+1;
        for(int y=0;y<=ntipe-1;y++)
        {
            sumberdaya[y]=sumberdaya[y]+kebutuhan[s][y];
        }
    }
}

tnow=tercepat;
sum1=0;
prejadwal=0;
for(int ab=0;ab<naktivitas-1;ab++)
{
    prejadwal=prejadwal+kegiatan[ab];
}

}

int dur=0;
for(int t=0;t<naktivitas;t++)
{
    if(ft[t]>dur)
    {
        dur=ft[t];
    }
}
//cek ada tidak aktivitas yang belum terselesaikan;
for(int r=0;r<=naktivitas-1;r++)
{
    if(ft[r]==0)
    {
        dur=100;
    }
}

x[i]=dur;
}

void loaddata1(int array[10][4],int array2[10],int array3[4],int array4[10][4])
{
    int i,j;

    for(i=0;i<=9;i++)
    {
        for(j=0;j<=3;j++)
        {
            pendahulu[i][j]=array[i][j];
        }
    }

    for(i=0;i<=9;i++)
    {
        durasi[i]=array2[i];
    }
}

```

```

}

for(i=0;i<=3;i++)
{
    sumberdaya[i]=array3[i];
}

for(i=0;i<=9;i++)
{
    for(j=0;j<=3;j++)
    {
        kebutuhan[i][j]=array4[i][j];
    }
}

//-----load data 2-----//

void loaddata2(int array[25][4],int array2[25],int array3[3],int array4[25][3])
{
    int i,j;

    for(i=0;i<=24;i++)
    {
        for(j=0;j<=3;j++)
        {
            pendahulu[i][j]=array[i][j];
        }
    }

    for(i=0;i<=24;i++)
    {
        durasi[i]=array2[i];
    }

    for(i=0;i<=2;i++)
    {
        sumberdaya[i]=array3[i];
    }

    for(i=0;i<=24;i++)
    {
        for(j=0;j<=2;j++)
        {
            kebutuhan[i][j]=array4[i][j];
        }
    }
}

void loaddata3(int array[60][4],int array2[60],int array3[4],int array4[60][4])
{
    int i,j;

    for(i=0;i<=59;i++)
    {

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```

        for(j=0;j<=3;j++)
        {
            pendahulu[i][j]=array[i][j];
        }
    }

    for(i=0;i<=59;i++)
    {
        durasi[i]=array2[i];
    }

    for(i=0;i<=3;i++)
    {
        sumberdaya[i]=array3[i];
    }

    for(i=0;i<=59;i++)
    {
        for(j=0;j<=3;j++)
        {
            kebutuhan[i][j]=array4[i][j];
        }
    }
}

void main()
{
    ofstream keluar;

    keluar.open("D:/hasilrunning.txt");

    int i,j,pilihdata,betanol,gamma,juumlahgbest;
    float alpha,d,l,jarak,a,b,y;
    float m1,maks_iterasi1,acak,acak1,f1,f2,rand,juumlah,gbest[600],gbestf[600][100];
    int maks_iterasi,k,t,terpilih[600];

    randomize();
    mulai:
    clrscr();
    cout<<"-----="<<endl;
    keluar<<"-----="<<endl;
    cout<<"      PROGRAM RCPSP Dengan Algoritma Firefly      "<<endl;
    keluar<<"      PROGRAM RCPSP Dengan Algoritma Firefly      "<<endl;
    cout<<"-----"<<endl<<endl;
    keluar<<"-----"<<endl<<endl;

    //----memasukkan parameter algoritma dan RPCSP-----//
    //----validasi parameter-----//
    cout<<"Masukkan banyaknya firefly (1-500):"<<endl;
    cin>>m1;
    d=floor(m1);
    l=d-m1;
    if(l!=0)
    {

```

```

goto mulai;
}
if(m1<1||m1>1000)
{
goto mulai;
}

cout<<"\nMasukkan banyaknya iterasi (1-1000) : "<<endl;
cin>>maks_iterasi1;
d=floor(maks_iterasi1);
l=d-maks_iterasi1;
if(l!=0)
{
goto mulai;
}

if((maks_iterasi1<1)||maks_iterasi1>1000)
{
goto mulai;
}

cout<<"\nMasukkan koefisien parameter random(alpha):(0-1)"<<endl;
cin>>alpha;
if((alpha<0)||alpha>1)
{
goto mulai;
}

gamma=1;
betano=1;

clrscr();
cout<<"Pilihan Data RCPSP : "<<endl;
cout<<"1. Pilihan Data Kecil "<<endl;
cout<<"2. Pilihan Data Sedang "<<endl;
cout<<"3. Pilihan Data Besar "<<endl<<endl;

cout<<"Masukkan Pilihan Data : "<<endl;
cin>>pilihdata;

switch(pilihdata)
{
case 1:
loaddata1(pendahulu1,durasi1,persediaansdaya1,kebutuhansdaya1);
naktivitas=10;
ntipe=4;
npendahulu=4;
break;

case 2:
loaddata2(pendahulu2,durasi2,persediaansdaya2,kebutuhansdaya2);
naktivitas=25;
ntipe=3;

```

```

npendahulu=4;
break;

case 3:
loaddata3(pendahulu3,durasi3,persediaansdaya3,kebutuhansdaya3);
naktivitas=60;
ntipe=4;
npendahulu=4;
break;
}
//casting parameter integer-----//
m=m1;
maks_iterasi=maks_iterasi1;

//-----

keluar<<endl;
keluar<<"PARAMETER ALGORITMA FIREFLY : "<<endl;
keluar<<"banyaknya firefly   : "<<m<<endl;
keluar<<"nilai alpha       : "<<alpha<<endl;
keluar<<"nilai betanol     : "<<betanol<<endl;
keluar<<"nilai gamma      : "<<gamma<<endl;
keluar<<"banyaknya iterasi  : "<<maks_iterasi<<endl<<endl;
keluar<<"DATA DALAM PROGRAM : "<<endl;

keluar<<"durasi   : "<<endl;
for(i=0;i<=naktivitas-1;i++)
{
keluar<<durasi[i]<<" ";
}

keluar<<endl<<endl;;
keluar<<"persediaan sumber daya tiap tipe : "<<endl;
for(i=0;i<=ntipe-1;i++)
{
keluar<<sumberdaya[i]<<" ";
}
keluar<<endl<<endl;;

keluar<<"kebutuhan sumber daya setiap aktivitas : "<<endl;
for(i=0;i<=naktivitas-1;i++)
{
l=i+1;
keluar<<"aktivitas-"<<l<<endl;
for(j=0;j<=ntipe-1;j++)
{
keluar<<kebutuhan[i][j]<<" ";
}
keluar<<endl;
}
keluar<<endl;

keluar<<"prasyarat (pendahulu) setiap aktivitas : "<<endl;
for(i=0;i<=naktivitas-1;i++)

```



```

{
l=i+1;
keluar<<"prasyarat aktivitas-"<<l<<endl;
    for(j=0;j<=npendahulu-1;j++)
        {
            keluar<<pendahulu[i][j]<<" ";
        }
keluar<<endl;
}
keluar<<endl;

//-----generate populasi awal random-----//
keluar<<"Generate Populasi Awal Fire fly :"<<endl;
for(int z=0;z<=m-1;z++)
{
l=z+1;
keluar<<"fire fly ke - "<<l<<endl;
    for(int r=0;r<=naktivitas-1;r++)
        {
            acak=random(100);
            acak1=99;
            firefly[z][r]=acak/acak1;
            keluar<<firefly[z][r]<<" ";
        }
keluar<<endl;
}

for(int i=0;i<=ntipe-1;i++)
{
sda[i]=sumberdaya[i];
}

bobot[0]=0;
for(int iter=1;iter<=maks_iterasi;iter++)
{

keluar<<endl;

//-----//
//-----hitung bobot (durasi) populasi awal-----//
keluar<<"HA SIL ITERASI "<<iter<<endl<<endl;

for(int i=0;i<=m-1;i++)
{
//perulangan tiap fire fly
hitungdurasi(i);
}

keluar<<"fire fly sebelum movement";
for(int h=0;h<=m-1;h++)
{
l=h+1;
keluar<<endl;
keluar<<"fire fly"<<l<<endl;
    for(int y=0;y<=naktivitas-1;y++)

```



```

    {
        f1=firefly[i][k];
        f2=firefly[j][k];
        d=pow(f1-f2,2);
        jumlah=jumlah+d;
    }
    jarak=sqrt(jumlah);
    y=pow(jarak,2);
    betanol=exp(-gamma*y);
    acak=random(100);
    acak1=99;
    rand=acak/acak1;

    for(int k=0; k<naktivitas-1;k++)
    {

        firefly[i][k]=(1-betanol)*firefly[i][k]+betanol*firefly[j][k]+alpha*(rand-0.5);
        if(firefly[i][k]<0)
        {
            firefly[i][k]=firefly[i][k]*-1;
        }
    }

    hitungdurasi(i);
    hitungintensitas(i);
}
}

keluar<<"fire fly sebelum movement";
for(int h=0;h<=m-1;h++)
{
    l=h+1;
    keluar<<endl;
    keluar<<"fire fly"<<l<<endl;
    for(int y=0;y<=naktivitas-1;y++)
    {
        keluar<<firefly[h][y]<<" ";
    }
    keluar<<endl;
}
keluar<<endl;

keluar<<"jadwal yang dibentuk setelah movement"<<endl;
for(int h=0;h<=m-1;h++)
{
    keluar<<"jadwal fire fly"<<h<<endl;
    keluar<<endl;
    for(int y=0;y<=naktivitas-1;y++)
    {
        keluar<<jadwaljadi[h][y]<<" ";
    }
}

```

```

    }
    keluar<<endl;
}
keluar<<endl;

keluar<<"durasi"<<endl;
for(int g=0;g<=m-1;g++)
{
    keluar<<x[g]<<endl;
}
keluar<<endl;

//menentukan g best populasi baru..

    best=intensitascahaya[0];
    for(int i=1; i<m; i++)
    {
        a=intensitascahaya[i];
        if(best<a)
        {
            best=a;
            j=i;
        }
    }

gbest[0]=best;
terpilih[0]=j;
jumlahgbest=1;
//mencari firefly dengan intensitas cahaya yang sama dengan g-best
for(int k=0;k<=m-1;k++)
{
    if(intensitascahaya[k]==gbest[0]&& k!=j)
    {
        gbest[jumlahgbest]=intensitascahaya[k];
        terpilih[jumlahgbest]=k;
        jumlahgbest++;
    }
}

for(int k=0;k<=jumlahgbest-1;k++)
{
    for(int l=0;l<=naktivitas-1;l++)
    {
        gbestf[k][l]=firefly[terpilih[k]][l];
    }
}

cout<<"firefly terbaik :"<<endl;
for(int k=0;k<=jumlahgbest-1;k++)
{
    cout<<"firefly ke-   :"<<terpilih[k]<<endl;
    for(int l=0;l<=naktivitas-1;l++)
    {

```

```

        cout<<gbestf[k][l]<<" ";
    }
    cout<<endl;
    cout<<"dengan durasi : "<<x[terpilih[k]<<endl;
}

keluar<<endl<<endl;
keluar<<"Penjadwalan Firefly Terbaik Iterasi"<<iter<<endl;
for(int u=0;u<=naktivitas-1;u++)
{
    keluar<<jadwaljadi[terpilih[0]][u]<<" ";
}
keluar<<"dengan durasi : "<<x[terpilih[0]<<endl;
keluar<<"Detail Start time dan Finish Time"<<endl;
for(int u=0;u<=naktivitas-1;u++)
{
    l=u+1;
    keluar<<"start time ["<<l<<"]"<<="<<stsem[terpilih[0]][u]<<endl;
    keluar<<"finish time ["<<l<<"]"<<="<<ftsem[terpilih[0]][u]<<endl<<endl;
}

//simpan seleksi terbaik periterasi
bobot[iter]=intensitascahaya[terpilih[0]];
for(int i=1;i<=naktivitas-1;i++)
{
    terbaik[iter][i]=gbestf[0][i];
}
durasif[iter]=x[terpilih[0]];

//movement terhadap firefly terbaik;

for(int k=0;k<=jumlahgbest-1;k++)
{
    for(int l=0;l<=naktivitas-1;l++)
    {
        acak=random(100);
        acakl=99;
        rand=acak/acakl;
        firefly[terpilih[k]][l]=firefly[terpilih[k]][l]+alpha*(rand-0.5);
        if(firefly[terpilih[k]][l]<0)
        {
            firefly[terpilih[k]][l]=firefly[terpilih[k]][l]*-1;
        }
    }
    hitungdurasi(terpilih[k]);
    hitungintensitas(terpilih[k]);
}

//menentukan movement pada g-best
}

clrscr();

```

```
cout<<"Hasil Akhir Running Program RPCSP :"<<endl<<endl;
```

```

        solusi=durasif[1];
for(int i=1;i<=maks_iterasi-1;i++)
{
    if(solusi>durasif[i])
    {
        solusi=durasif[i];
        indeks=i;
    }
}

```

```

cout<<"Penjadwalan Firefly Terbaik :";
for(int u=0;u<=naktivitas-1;u++)
{
    cout<<jadwaljadwal[terpilih[0]][u]<<" ";
}
cout<<endl;

```

```
cout<<endl;
```

```

cout<<"dengan durasi      :"<<endl;
cout<<solusi;

```

```

//-----bobot akhir-----
getch();
}

```

## Lampiran 5 : Output Program

### 1. 10 Aktivitas 4 tipe sumber daya

$Maks\_iterasi = 100$   
 $\alpha = 0.1$   
 $m = 10$

#### Populasi awal

nilai prioritas tiap aktivitas ( 10 firefly )

---



---

```

firefly ke- 1
0.686869 0.414141 0.333333 0.171717 0.151515 0.262626 0.40404 0.282828 0.111111 0.363636
firefly ke- 2
0.090909 0.050505 0.474747 0.868687 0.818182 0.666667 0.070707 0.161616 0.858586 0.333333
firefly ke- 3
0.727273 0.434343 0.909091 0.979798 0.747475 0.787879 0.717172 0.525253 0.777778 0.959596
firefly ke- 4
0.868687 0.606061 0.141414 0.717172 0.030303 0.868687 0.161616 0.747475 0.858586 0.707071
firefly ke- 5
0.464646 0.707071 0.838384 0.080808 0.79798 0.585859 0.59596 0.585859 0.424242 0.222222
firefly ke- 6
0.232323 0.565657 0.949495 0.969697 0.929293 0.171717 0.464646 0.252525 0.494949 0.383838
firefly ke- 7
0.878788 0.707071 0.464646 1 0 0.79798 0.888889 0.969697 0.747475 0.444444
firefly ke- 8
0.292929 0.181818 0.565657 0.89899 0.262626 0.484848 0.767677 0.929293 0.888889 0.909091
firefly ke- 9
0.414141 0.353535 0.333333 0.161616 0.545455 0.707071 0.131313 0.929293 0.111111 0.30303
firefly ke- 10
0.30303 0.272727 1 0.444444 0.535354 0.818182 0.919192 0.656566 0.333333 0.89899

```

---



---

#### Iterasi 1

```

firefly1
0.656061 0.383333 0.302525 0.140909 0.120707 0.231818 0.373232 0.25202 0.080303 0.363636
firefly2
0.090909 0.050505 0.474747 0.868687 0.818182 0.666667 0.070707 0.161616 0.858586 0.333333
firefly3
0.702525 0.409596 0.884344 0.955051 0.722727 0.763131 0.692424 0.500505 0.75303 0.959596
firefly4
0.901515 0.638889 0.174242 0.75 0.0631313 0.901515 0.194444 0.780303 0.891414 0.707071
firefly5
0.464646 0.707071 0.838384 0.080808 0.79798 0.585859 0.59596 0.585859 0.424242 0.222222
firefly6
0.232323 0.565657 0.949495 0.969697 0.929293 0.171717 0.464646 0.252525 0.494949 0.383838
firefly7
0.733333 0.561616 0.319192 0.854545 0.0151515 0.652525 0.743434 0.824242 0.60202 0.444444
firefly8
0.213131 0.10202 0.485859 0.819192 0.182828 0.405051 0.687879 0.849495 0.809091 0.909091
firefly9
0.414141 0.353535 0.333333 0.161616 0.545455 0.707071 0.131313 0.929293 0.111111 0.30303
firefly10
0.283838 0.253535 0.980808 0.425253 0.516162 0.79899 0.9 0.637374 0.314141 0.89899

```

#### Iterasi 100

```

firefly1
0.769698 0.49697 0.416162 0.272727 0.267677 0.345455 0.486869 0.365657 0.270707 0.363636
firefly2
0.419192 0.418182 0.613131 1.00505 0.887879 0.862627 0.491919 0.531313 0.99495 0.155556
firefly3

```

1.65909 1.33485 1.83384 1.85101 1.37121 1.88535 1.50657 1.44192 1.96717 0.859091  
firefly4  
2.63737 2.37475 1.9101 2.48586 1.79899 2.63737 1.9303 2.51616 2.62727 0.707071  
firefly5  
0.574242 0.470202 0.697475 0.244949 0.435858 0.144949 0.446969 0.560101 0.701515 0.0489899  
firefly6  
0.0409091 0.0429294 0.560101 0.664142 0.0661621 0.0419191 0.508587 0.0409091 0.039899 0.733838  
firefly7  
0.655556 0.617172 0.616162 0.776768 0.617172 0.636364 0.665657 0.746465 0.619192 0.444444  
firefly8  
0.386869 0.383838 0.441414 0.774749 0.384848 0.393939 0.643436 0.805052 0.764648 0.909091  
firefly9  
0.591414 0.505555 0.263131 0.334848 0.872222 1.10859 0.538889 0.818687 0.0227273 0.509091  
firefly10  
0.10303 0.10404 0.622222 0.107071 0.157576 0.440404 0.541414 0.278788 0.104041 0.89899

### Penjadwalan Firefly Terbaik

3 1 2 6 9 8 5 4 7 10 dengan durasi : 27

Detail Start time dan Finish Time :

start time [1]=0

finish time [1]=9

start time [2]=0

finish time [2]=5

start time [3]=0

finish time [3]=9

start time [4]=15

finish time [4]=25

start time [5]=9

finish time [5]=17

start time [6]=5

finish time [6]=6

start time [7]=17

finish time [7]=27

start time [8]=9

finish time [8]=15

start time [9]=9

finish time [9]=12

start time [10]=17

finish time [10]=26



## 2. 25 Aktivitas 3 tipe sumber daya

$$\begin{aligned} \text{Maks\_iterasi} &= 100 \\ \alpha &= 0.1 \\ m &= 30 \end{aligned}$$

Populasi awal

nilai prioritas tiap aktivitas ( 10 firefly )

---

```

firefly ke- 1
0.767677 0.585859 0.808081 0.010101 0.434343 0.232323 0.868687 0.444444 0.101010 0.131313 0.646465 0.787879
0.191919 0.505050 0.959596 0.404040 0.444444 0.040404 0.656566 0.616162 0.979798 0.616162 0.989899 0.656566
0.646465
firefly ke- 2
0.383838 0.848485 0.555556 0.030303 0.848485 0.090909 0.020202 0.555556 0.323232 0.171717 0.030303 0.545455
0.090909 0.535354 0.484848 0.393939 0.919192 0.131313 0.818182 0.515152 0.787879 0.838384 0.484848 0.969697
0.646465
firefly ke- 3
0.616162 0.494949 0.59596 0.59596 0.929293 0.171717 0.474747 0.949495 0.989899 0.424242 0.838384 0.373737
0.787879 0.353535 0.59596 0.666667 0.232323 0.828283 0.434343 0.202020 0.616162 0.89899 0.080808 0.404040 0.828283
firefly ke- 4
0.555556 0.646465 0.060606 0.363636 0.989899 0.727273 0.484848 0.606061 0.464646 0.79798 0.616162 0.515152
0.494949 0.979798 0.59596 0.111111 0.69697 0.787879 0.969697 0.50505 0.878788 0.252525 0.959596 0.272727 0.333333
firefly ke- 5
0.50505 0 0.686869 0.828283 0.010101 0.909091 0.434343 0.727273 0.666667 0.646465 0.636364 0.828283 0.0909091
0.343434 0.747475 0.424242 0.181818 0.171717 0.747475 0.494949 0.050505 0.989899 0.50505 0 0.707071
firefly ke- 6
0.040404 0.383838 0.474747 0.353535 0.313131 0.59596 0.626263 0.909091 0.525253 0.989899 0.565657 0.0808081
0.646465 0.848485 0.242424 0.525253 0.888889 0.787879 0.040404 0.585859 0.787879 0.010101 0.292929 0 0.40404
firefly ke- 7
0.888889 0.313131 0.373737 0.323232 0.333333 0.575758 0.151515 0.424242 0.121212 0.777778 0.464646 0.010101
0.818182 0.373737 0.212121 0.494949 0.040404 0.393939 0.111111 0.333333 0.424242 0.353535 0.363636 0.111111
0.121212
firefly ke- 8
0.929293 0.272727 0.777778 0.515152 0.606061 0.353535 0.50505 0.747475 0.161616 0.464646 0.828283 0.484848
0.242424 0.191919 0.111111 0.323232 0.111111 0.858586 0.40404 0.818182 0.939394 0.222222 0.363636 0.949495
0.262626
firefly ke- 9
0.292929 0.636364 0.888889 0.262626 0.818182 0.727273 0.252525 0.606061 0.777778 0.030303 0.050505 0.878788
0.181818 0.757576 0.232323 0.89899 0.262626 0.242424 0.787879 0.0909091 0.808081 0.30303 0.151515 0.878788
0.191919
firefly ke- 10
0.484848 0.838384 0.929293 0.474747 0.030303 0.555556 0.373737 0.292929 0.828283 0.484848 0.0808081 0.737374
0.0707071 0.040404 0.949495 0.666667 0.686869 0.484848 0.585859 0.474747 0.161616 0.343434 0.646465 0.676768
0.646465
firefly ke- 11
0.525253 0.232323 0.949495 0.848485 0.323232 0.828283 0.909091 0.0707071 0.222222 0.828283 0.949495 0.939394
0.424242 0.272727 0.161616 0.525253 0.545455 0.40404 0.414141 0.0909091 0.979798 0.848485 0.949495 0.79798
0.343434
firefly ke- 12
0.929293 0.424242 0.181818 0.0707071 0.141414 0.282828 0.373737 0.888889 0.151515 0.606061 0.454545 0.717172
0.727273 0.161616 0.59596 0.262626 0.636364 0.0707071 0.616162 0.353535 0.737374 0.79798 0.737374 0.20202
0.484848
firefly ke- 13
0.424242 0.323232 0.79798 0.050505 0.40404 0.0707071 1 0.777778 0.79798 0.676768 0.444444 0.959596 0.040404
0.808081 0.525253 0.141414 0.777778 0.727273 0.484848 0.50505 0.858586 0.626263 0.888889 0.656566 0.646465
firefly ke- 14
0.656566 0.747475 0.363636 0.10101 0.0606061 0.20202 0.636364 0.676768 0.343434 0.747475 0.59596 0.858586
0.737374 0.0707071 0.484848 0.636364 0.828283 0.333333 0.515152 0.747475 0.494949 0.818182 0.656566 0.575758
0.59596
firefly ke- 15
0.161616 0.0909091 0.414141 0.535354 0.40404 0.333333 0.222222 0.363636 0.272727 0.767677 0.272727 0.666667
0.474747 0.282828 0.79798 0.353535 0.40404 0.747475 0.464646 0.393939 0.525253 0.69697 0.393939 0.212121 0.737374

```

## firefly ke- 16

0.949495 0.0808081 0.50505 0.161616 0.585859 0.59596 0.515152 0.848485 0.686869 0.919192 0.141414 0.373737  
 0.949495 0.616162 0.89899 0.787879 0.10101 0.656566 0.0808081 0.040404 0.919192 0.787879 0.373737 0.808081  
 0.111111

## firefly ke- 17

0.858586 0.30303 0.383838 0.424242 0.40404 0.353535 0.383838 0.262626 0.484848 0.444444 0.606061 0.131313  
 0.717172 0.363636 0.979798 0.393939 0.282828 0.707071 0.949495 0.282828 0.383838 0.646465 0.393939 0.181818  
 0.040404

## firefly ke- 18

0.444444 0.626263 0.79798 0.171717 0.242424 0.848485 0.171717 0.747475 0.727273 0.393939 0.222222 0.10101 0.10101  
 0.474747 0.0707071 0.808081 0.838384 0.707071 0.151515 0.10101 0.222222 0.878788 0.89899 0.747475 0.414141

## firefly ke- 19

0.474747 0.717172 0.40404 0.363636 0.323232 0.919192 0.454545 0.151515 0.191919 0.585859 0.0808081 0.111111  
 0.262626 0.181818 0.232323 0.434343 0.979798 0.636364 0.626263 0.535354 0.636364 0.989899 0.616162 0.686869  
 0.0606061

## firefly ke- 20

0.919192 0.919192 0.0909091 0.59596 0.262626 0.20202 0.727273 0.30303 0.434343 0.252525 0.959596 0.818182  
 0.0606061 0.363636 0.737374 0.50505 0.626263 0.89899 0.919192 0.292929 0.79798 0.020202 0.565657 0.59596 0.777778

## firefly ke- 21

0.777778 0.848485 0.131313 0.686869 0.707071 0.59596 0.151515 0.393939 0.0707071 0.030303 0.929293 0.848485  
 0.787879 0.252525 0.939394 0.565657 0.525253 0.383838 0.0909091 0.0707071 0.414141 0.979798 0.161616 0.383838  
 0.909091

## firefly ke- 22

0.727273 0.121212 0.959596 0.464646 0.232323 0.121212 0.232323 0.555556 0.454545 0.0606061 0.161616 0.282828  
 0.0909091 0.59596 0.858586 0.393939 0.131313 0.20202 0.616162 0.727273 0.636364 0.212121 0 0.686869 0.79798

## firefly ke- 23

0.020202 0.171717 0.606061 0.232323 0.151515 0.979798 0.616162 0.040404 0.141414 0.333333 0.818182 0.181818  
 0.565657 0.464646 0.262626 0.111111 0.818182 0.020202 0.707071 0.474747 0.414141 0.454545 0.434343 0.050505  
 0.030303

## firefly ke- 24

0.323232 0.737374 0.919192 0.727273 0.252525 0.050505 0.909091 0.161616 0.555556 0.737374 0.212121 0.161616  
 0.69697 0.747475 0.979798 0.757576 0.282828 0.40404 0.535354 0.020202 0.535354 0.737374 0.919192 0.737374  
 0.535354

## firefly ke- 25

0.10101 0.333333 0.252525 0.787879 0.363636 0.010101 0.0808081 0.565657 0.69697 0.20202 0.565657 0.494949  
 0.868687 0.333333 0.707071 0.353535 0.909091 0.020202 0.444444 0.282828 0.191919 0.626263 0.565657 0.939394  
 0.727273

## firefly ke- 26

0.474747 0.757576 0.636364 0.585859 0.929293 0.383838 0.545455 0.363636 0.494949 0.0707071 0.333333 0.686869  
 0.50505 0.767677 0.0808081 0.111111 0.989899 0.323232 0.242424 0.363636 0.050505 0.838384 0.454545 0.717172  
 0.323232

## firefly ke- 27

0.676768 0.323232 0.979798 0.676768 0.69697 0.545455 0.363636 0.878788 0.373737 0.767677 0.747475 0.585859  
 0.161616 0.171717 0.989899 0.232323 0.0808081 1 0.727273 0.848485 0.030303 0.919192 0.454545 0.777778 0.50505

## firefly ke- 28

0.727273 0.535354 0.818182 0.121212 0.777778 0.515152 0.151515 0.383838 0.0909091 0 1 0.727273 0.0707071 0.636364  
 0.0909091 0.606061 0.878788 0.787879 0.727273 0.363636 0.383838 0.171717 0.969697 0.747475 0.818182

## firefly ke- 29

0.161616 0.222222 0.242424 0.656566 0.040404 0.535354 0.111111 0.565657 0.909091 0.757576 0.545455 0.969697  
 0.161616 0.272727 0.040404 0.929293 0.414141 0.494949 0.050505 0.979798 0.161616 0.707071 0.383838 0.747475  
 0.424242

## firefly ke- 30

0.161616 0.353535 0.747475 0.636364 0.939394 0.79798 0.666667 0.171717 0.989899 0.252525 0.0808081 0.373737  
 0.242424 0.565657 0.0808081 0.232323 0.646465 0.525253 0.959596 0.454545 0.454545 0.40404 0.545455 0.181818  
 0.0808081

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## Iterasi 1

## firefly1

0.765657 0.583838 0.806061 0.0393939 0.432323 0.230303 0.866667 0.442424 0.0989899 0.129293 0.644444 0.785859  
0.189899 0.50303 0.957576 0.40202 0.442424 0.0383838 0.654545 0.614141 0.977778 0.614141 0.987879 0.654545  
0.646465

## firefly2

0.393939 0.858586 0.565657 0.040404 0.858586 0.10101 0.030303 0.565657 0.333333 0.181818 0.040404 0.555556 0.10101  
0.545455 0.49495 0.40404 0.929293 0.141414 0.828283 0.525253 0.79798 0.848485 0.49495 0.979798 0.646465

## firefly3

0.596465 0.475253 0.576263 0.576263 0.909596 0.15202 0.45505 0.929798 0.970202 0.404545 0.818687 0.35404 0.768182  
0.333838 0.576263 0.64697 0.212626 0.808586 0.414646 0.182323 0.596465 0.879293 0.0611111 0.384343 0.828283

## firefly4

0.471717 0.562626 0.0606061 0.279798 0.906061 0.643434 0.40101 0.522222 0.380808 0.714141 0.532323 0.431313  
0.411111 0.895959 0.512121 0.0272727 0.613131 0.70404 0.885859 0.421212 0.794949 0.168687 0.875758 0.188889  
0.333333

## firefly5

0.467172 0.0429293 0.64899 0.790404 0.0530303 0.871212 0.396465 0.689394 0.628788 0.608586 0.598485 0.790404  
0.0530303 0.305556 0.709596 0.386364 0.143939 0.133838 0.709596 0.457071 0.0308081 0.95202 0.467172 0.0429293  
0.707071

## firefly6

0.0262626 0.369697 0.460606 0.339394 0.29899 0.581818 0.612121 0.89495 0.511111 0.975758 0.551515 0.0666667  
0.632323 0.834343 0.228283 0.511111 0.874748 0.773737 0.0262626 0.571717 0.773737 0.0040404 0.278788 0.0131313  
0.40404

## firefly7

0.861111 0.285354 0.34596 0.295455 0.305556 0.54798 0.123737 0.396465 0.0934343 0.75 0.436869 0.0590909 0.790404  
0.34596 0.184343 0.467172 0.0631313 0.366162 0.0833333 0.305556 0.396465 0.325758 0.335859 0.0833333 0.121212

## firefly8

1.06515 0.408586 0.913637 0.65101 0.741919 0.489394 0.640909 0.883333 0.297475 0.600505 0.964142 0.620707 0.378283  
0.327778 0.24697 0.459091 0.24697 0.994445 0.539899 0.954041 1.07525 0.358081 0.499495 1.08535 0.262626

## firefly9

0.242424 0.585859 0.838384 0.212121 0.767677 0.676768 0.20202 0.555556 0.727273 0.079798 0.0737374 0.828283  
0.131313 0.707071 0.181818 0.848485 0.212121 0.191919 0.737374 0.0808081 0.757576 0.252525 0.10101 0.828283  
0.191919

## firefly10

0.420202 0.773737 0.864646 0.410101 0.0494949 0.490909 0.309091 0.228283 0.763636 0.420202 0.0252525 0.672727  
0.0323232 0.0393939 0.884848 0.60202 0.622222 0.420202 0.521212 0.410101 0.0969697 0.278788 0.581818 0.612121  
0.646465

## firefly11

0.469697 0.176768 0.893939 0.792929 0.267677 0.772727 0.853535 0.0646465 0.166667 0.772727 0.893939 0.883838  
0.368687 0.217172 0.106061 0.469697 0.489899 0.348485 0.358586 0.059596 0.924242 0.792929 0.893939 0.742424  
0.343434

## firefly12

1.11465 0.609596 0.367172 0.256061 0.326768 0.468182 0.559091 1.07424 0.336869 0.791414 0.639899 0.902525 0.912626  
0.34697 0.781313 0.44798 0.821717 0.256061 0.801515 0.538889 0.922727 0.983333 0.922727 0.387374 0.484848

## firefly13

0.280808 0.179798 0.654545 0.0363636 0.260606 0.0565657 0.856566 0.634343 0.654545 0.533333 0.30101 0.816162  
0.0424242 0.664646 0.381818 0.0414142 0.634343 0.583838 0.341414 0.361616 0.715151 0.482828 0.745454 0.513131  
0.646465

## firefly14

0.672727 0.763636 0.379798 0.117172 0.0767677 0.218182 0.652525 0.692929 0.359596 0.763636 0.612121 0.874747  
0.753535 0.0868687 0.50101 0.652525 0.844444 0.349495 0.531313 0.763636 0.511111 0.834343 0.672727 0.591919  
0.59596

## firefly15

0.114141 0.0767677 0.366667 0.487879 0.356566 0.285859 0.174748 0.316162 0.225253 0.720202 0.225253 0.619192  
0.427273 0.235354 0.750505 0.306061 0.356566 0.7 0.417172 0.346465 0.477778 0.649495 0.346465 0.164647 0.737374

## firefly16

0.970202 0.101515 0.525758 0.182323 0.606566 0.616667 0.535859 0.869192 0.707576 0.939899 0.162121 0.394444  
0.970202 0.636869 0.919697 0.808586 0.121717 0.677273 0.101515 0.0611111 0.939899 0.808586 0.394444 0.828788  
0.111111

## firefly17

0.858081 0.302525 0.383333 0.423737 0.403535 0.35303 0.383333 0.262121 0.484343 0.443939 0.605556 0.130808  
0.716667 0.363131 0.979293 0.393434 0.282323 0.706566 0.94899 0.282323 0.383333 0.64596 0.393434 0.181313 0.040404

## firefly18

0.442424 0.624242 0.79596 0.169697 0.240404 0.846465 0.169697 0.745455 0.725253 0.391919 0.220202 0.0989899  
 0.0989899 0.472727 0.0686869 0.806061 0.836364 0.705051 0.149495 0.0989899 0.220202 0.876768 0.89697 0.745455  
 0.414141  
 firefly19  
 0.494444 0.736869 0.423737 0.383333 0.342929 0.938889 0.474242 0.171212 0.211616 0.605556 0.100505 0.130808  
 0.282323 0.201515 0.25202 0.45404 0.999495 0.656061 0.64596 0.55505 0.656061 1.0096 0.635859 0.706566 0.0606061

firefly20

0.863131 0.863131 0.0348485 0.539899 0.206566 0.14596 0.671212 0.24697 0.378283 0.196465 0.903535 0.762121  
 0.00454545 0.307576 0.681313 0.44899 0.570202 0.842929 0.863131 0.236869 0.741919 0.00454545 0.509596 0.539899  
 0.777778

firefly21

0.807071 0.877778 0.160606 0.716162 0.736364 0.625253 0.180808 0.423232 0.157576 0.160606 0.958586 0.877778  
 0.817172 0.281818 0.968687 0.594949 0.554545 0.413131 0.159596 0.157576 0.443434 1.00909 0.190909 0.413131  
 0.909091

firefly22

0.816162 0.210101 1.04848 0.553535 0.321212 0.210101 0.321212 0.644444 0.543434 0.149495 0.250505 0.371717  
 0.179798 0.684848 0.947475 0.482828 0.220202 0.290909 0.705051 0.816162 0.725253 0.30101 0.138384 0.775758 0.79798

firefly23

0.20101 0.292929 0.727273 0.353535 0.272727 1.10101 0.737374 0.191919 0.262626 0.454545 0.939394 0.30303 0.686869  
 0.585859 0.383838 0.232323 0.939394 0.20101 0.828283 0.59596 0.535354 0.575758 0.555556 0.181818 0.030303

firefly24

0.323232 0.737374 0.919192 0.727273 0.252525 0.050505 0.909091 0.161616 0.555556 0.737374 0.212121 0.161616  
 0.69697 0.747475 0.979798 0.757576 0.282828 0.40404 0.535354 0.020202 0.535354 0.737374 0.919192 0.737374 0.535354

firefly25

0.0176768 0.25 0.169192 0.704546 0.280303 0.0106061 0.00151515 0.482323 0.613636 0.118687 0.482323 0.411616  
 0.785354 0.25 0.623737 0.270202 0.825758 0.00959596 0.361111 0.199495 0.108586 0.542929 0.482323 0.856061 0.727273

firefly26

0.549495 0.832323 0.711111 0.660606 1.00404 0.458586 0.620202 0.438384 0.569697 0.145455 0.408081 0.761616  
 0.579798 0.842424 0.155556 0.185859 1.06465 0.39798 0.317172 0.438384 0.125253 0.913131 0.529293 0.791919 0.323232

firefly27

0.726768 0.373232 1.0298 0.726768 0.74697 0.595455 0.413636 0.928788 0.423737 0.817677 0.797475 0.635859 0.211616  
 0.221717 1.0399 0.282323 0.130808 1.05 0.777273 0.898485 0.0944444 0.969192 0.504546 0.827778 0.50505

firefly28

0.505051 0.313131 0.59596 1.97553e-11 0.555556 0.292929 0.0151515 0.161616 0.00505049 0.0040404 0.777778 0.505051  
 0.00101009 0.414141 0.00505049 0.383838 0.656566 0.565657 0.505051 0.141414 0.161616 0.0353535 0.747475 0.525253  
 0.818182

firefly29

0.277778 0.338384 0.358586 0.727272 0.164646 0.651515 0.227273 0.681818 1.02525 0.873737 0.661616 1.08586 0.277778  
 0.388889 0.164646 1.04545 0.530303 0.611111 0.166667 1.09596 0.277778 0.823232 0.5 0.863636 0.424242

firefly30

0.114646 0.306566 0.700505 0.589394 0.892424 0.75101 0.619697 0.124747 0.942929 0.205556 0.0338384 0.326768  
 0.195455 0.518687 0.0338384 0.185354 0.599495 0.478283 0.912626 0.407576 0.407576 0.357071 0.498485 0.134848  
 0.0808081

### Populasi Firefly Terbaik (Iterasi 77)

firefly1

1.83586 1.65404 1.87626 1.35202 1.50252 1.33788 1.93687 1.51263 1.35202 1.35101 1.71465 1.85606 1.35505 1.57323  
 2.02778 1.47222 1.51263 1.35303 1.72475 1.68435 2.04798 1.68435 2.05808 1.72475 0.646465

firefly2

0.543434 0.647476 0.542424 0.541414 0.647476 0.543434 0.539394 0.542424 0.542424 0.543434 0.541414 0.543434  
 0.543434 0.539394 0.539394 0.538384 0.718183 0.540404 0.617173 0.539394 0.58687 0.637375 0.539394 0.768688  
 0.646465

firefly3

1.14242 1.11616 1.05859 1.05455 1.50909 0.685859 1.08788 1.5495 1.49899 0.956566 1.33232 0.954546 1.35556 0.874748  
 1.17273 1.28788 0.869697 1.38889 0.944445 0.828283 1.12525 1.44343 0.59798 0.950506 0.864141

firefly4

0.181818 0.192929 0.181818 0.19596 0.19596 0.179798 0.179798 0.179799 0.179798 0.19293 0.186869 0.182829 0.189899  
 0.184848 0.188889 0.19394 0.189899 0.191919 0.178788 0.191919 0.172728 0.183839 0.183838 0.194949 0.24596

firefly5

0.357577 0.355557 0.367678 0.481819 0.355557 0.562628 0.355557 0.380809 0.359597 0.356567 0.359597 0.481819  
 0.355557 0.357577 0.401011 0.357577 0.355557 0.355557 0.401011 0.354547 0.355557 0.643437 0.357577 0.355557  
 0.707071

firefly6

0.179293 0.180303 0.181313 0.177273 0.177272 0.183333 0.202525 0.176263 0.177273 0.290404 0.185354 0.198485  
 0.179293 0.258081 0.220707 0.183333 0.178283 0.177273 0.179293 0.203536 0.179293 0.203535 0.180303 0.183334  
 0.457576  
 firefly7  
 1.26667 1.1202 1.12525 1.11818 1.12121 1.12323 1.1202 1.12525 1.12121 1.18687 1.11919 1.11919 1.20404 1.12323  
 1.12525 1.1202 1.12222 1.12222 1.12525 1.12525 1.12121 1.12121 1.12424 1.12323 0.162121  
 firefly8  
 0.0202017 0.0171718 0.0101011 0.00404063 0.0131315 0.0181819 0.00505059 0.016161 0.011111 0.00303013 0.0040404  
 0.00505057 0.0191921 0.0161612 0.015151 0.00404063 0.00808136 0.0161613 0.0131315 0.0191916 0.00303013 0.0090914  
 0.00101 8.09423e-08 0.226263  
 firefly9  
 1.03788 1.38131 1.63384 1.00758 1.56313 1.47222 0.997478 1.35101 1.52273 0.875255 0.869194 1.62374 0.92677 1.50253  
 0.977275 1.64394 1.00758 0.987376 1.53283 0.876265 1.55303 1.04798 0.896467 1.62374 0.191919  
 firefly10  
 0.789899 0.797979 0.80505 0.794949 0.792929 0.811111 0.809091 0.794949 0.791919 0.791919 0.789899 0.791919 0.80303  
 0.792929 0.881818 0.80505 0.810101 0.808081 0.789899 0.791919 0.791919 0.79394 0.792929 0.794949 0.691414  
 firefly11  
 2.9899 2.72222 3.41414 3.31313 2.78788 3.29293 3.37374 2.71919 2.71919 3.29293 3.41414 3.40404 2.88889 2.73737  
 2.72626 2.9899 3.0101 2.86869 2.87879 2.71919 3.44445 3.31313 3.41414 3.26263 0.343434  
 firefly12  
 1.04596 0.676263 0.630808 0.685354 0.632829 0.671213 0.64394 1.00859 0.629798 0.801517 0.64495 0.897476 0.889396  
 0.64192 0.7399 0.693435 0.843941 0.618687 0.754041 0.650001 0.901517 1.00051 0.853031 0.674243 0.44596  
 firefly13  
 1.62879 1.6197 1.61667 1.61768 1.62576 1.63889 1.7995 1.62273 1.61566 1.63889 1.61465 1.74495 1.62677 1.61869  
 1.61566 1.62172 1.61869 1.62677 1.63384 1.63889 1.65 1.61869 1.68535 1.62677 0.603535  
 firefly14  
 1.01616 1.10707 0.810101 0.80303 0.80303 0.80303 0.995959 1.03636 0.80505 1.10707 0.955555 1.21818 1.09697 0.80303  
 0.844444 0.995959 1.18788 0.80909 0.874747 1.10707 0.854545 1.17778 1.01616 0.935353 0.59596  
 firefly15  
 1.74242 1.74141 1.73535 1.76566 1.73838 1.73838 1.73838 1.73838 1.74243 1.98384 1.74142 1.91818 1.73737 1.7394  
 2.07879 1.73838 1.73939 2.02829 1.72828 1.7303 1.82121 1.93636 1.73838 1.74141 0.75404  
 firefly16  
 0.0964645 0.085354 0.0893938 0.0924248 0.0883836 0.0893937 0.0843434 0.0914144 0.085355 0.0873736 0.0833338  
 0.0964641 0.0893942 0.0873748 0.0944445 0.085353 0.085354 0.0924256 0.0934347 0.085353 0.0964649 0.0873733  
 0.0873741 0.0843447 0.170707  
 firefly17  
 0.987879 0.475757 0.636364 0.641414 0.551515 0.687879 0.509091 0.444444 0.549495 0.613131 0.812122 0.368687  
 0.955556 0.739394 1.19394 0.568687 0.360606 0.906061 1.1798 0.408081 0.541414 0.917172 0.555555 0.361616 0.128283  
 firefly18  
 0.686364 0.677274 0.788385 0.685355 0.686365 0.83889 0.685355 0.73788 0.717678 0.685355 0.685355 0.685354 0.685354  
 0.691415 0.688385 0.798486 0.828789 0.697476 0.687375 0.685354 0.685355 0.869193 0.889395 0.73788 0.414141  
 firefly19  
 1.71818 1.95556 1.52626 1.52222 1.58384 1.9798 1.57879 1.4101 1.45455 1.67172 1.43435 1.40303 1.4495 1.43232 1.40202  
 1.75455 2.17778 1.81111 1.68889 1.70101 1.70808 2.15556 1.68182 1.60909 0.0429293  
 firefly20  
 0.307071 0.307071 0.307071 0.307071 0.307071 0.307071 0.307071 0.307071 0.307071 0.307071 0.307071 0.305052 0.305051  
 0.307071 0.307071 0.307071 0.307071 0.305051 0.306061 0.307071 0.307071 0.306061 0.307071 0.306061 0.307071  
 0.777778  
 firefly21  
 0.0828278 0.075758 0.0787879 0.0838386 0.080808 0.0797977 0.079798 0.0828282 0.079798 0.0797978 0.0797982  
 0.078788 0.0838383 0.0838384 0.0757577 0.0828282 0.0757577 0.0818181 0.0797977 0.0777776 0.0757578 0.083838  
 0.0828282 0.0838386 0.834343  
 firefly22  
 0.139394 0.0828283 0.40101 0.10101 0.147475 0.1 0.110101 0.0747467 0.0878789 0.109091 0.109091 0.110101 0.0939393  
 0.0767671 0.3 0.0696968 0.155555 0.10505 0.136363 0.0757578 0.146464 0.0818182 0.0767676 0.225253 0.89596  
 firefly23  
 0.0126264 0.0186868 0.0186871 0.0186869 0.0136363 0.169191 0.016667 0.0126263 0.0156565 0.0146464 0.145959  
 0.0156565 0.0176765 0.0146462 0.0166667 0.018687 0.0924237 0.0166667 0.0095966 0.0156568 0.0146465 0.0146466  
 0.00858593 0.0186867 0.157576  
 firefly24  
 0.301515 0.626768 0.420707 0.735858 0.260101 0.298485 0.891414 0.340909 0.302525 0.64697 0.167172 0.333838  
 0.382323 0.35505 0.84394 0.342929 0.296465 0.389394 0.309596 0.295455 0.279293 0.493434 0.743939 0.778283 0.70202  
 firefly25

0.413637 0.426768 0.410606 0.596466 0.410607 0.420707 0.420707 0.408586 0.505556 0.415657 0.408586 0.422728  
 0.677273 0.426768 0.515657 0.406566 0.717678 0.420707 0.413637 0.420707 0.418687 0.434849 0.408586 0.747981  
 0.727273

firefly26

0.919699 1.20253 1.08132 1.03081 1.37424 0.828789 0.990407 0.808587 0.939901 0.64394 0.778284 1.13182 0.950002  
 1.21263 0.64495 0.64596 1.43485 0.768183 0.687374 0.808587 0.64697 1.28334 0.899497 1.16212 0.323232

firefly27

1.42323 1.16364 1.72626 1.42323 1.44343 1.29192 1.14747 1.62525 1.15758 1.51414 1.49394 1.33232 1.15253 1.15354  
 1.73636 1.15556 1.15657 1.74646 1.47374 1.59495 1.15152 1.66566 1.20101 1.52424 0.50505

firefly28

1.65252 1.65152 1.65152 1.65152 1.65152 1.65152 1.65252 1.65152 1.6505 1.65152 1.65859 1.65252 1.65152 1.65252  
 1.6505 1.65252 1.6505 1.65152 1.65252 1.65152 1.65152 1.65252 1.64848 1.6505 0.818182

firefly29

1.18232 1.1904 1.18333 1.54697 1.18838 1.42576 1.18939 1.45606 1.79949 1.64798 1.43586 1.8601 1.18232 1.1803 1.18838  
 1.8197 1.30455 1.38535 1.18939 1.8702 1.18232 1.59747 1.27424 1.63788 0.424242

firefly30

0.646465 0.722222 1.08889 0.991919 1.27879 1.12424 0.956566 0.653535 1.36263 0.712121 0.671717 0.757576 0.608081  
 0.940404 0.639394 0.631313 0.99596 0.819192 1.32727 0.80707 0.774747 0.770707 0.853535 0.69495 0.0020202

### Penjadwalan Solusi Terbaik

#### Penjadwalan Firefly Terbaik Iterasi77

1 2 5 3 6 7 4 8 11 10 13 15 18 19 9 22 14 12 23 17 16 20 21 25 24 dengan durasi : 66

Detail Start time dan Finish Time :

start time [1]=0

finish time [1]=5

start time [2]=5

finish time [2]=10

start time [3]=12

finish time [3]=15

start time [4]=22

finish time [4]=26

start time [5]=10

finish time [5]=12

start time [6]=15

finish time [6]=16

start time [7]=16

finish time [7]=22

start time [8]=26

finish time [8]=32

start time [9]=46

finish time [9]=47

start time [10]=29

finish time [10]=32

start time [11]=26

finish time [11]=29

start time [12]=47

finish time [12]=50

start time [13]=32

finish time [13]=35

start time [14]=47

finish time [14]=53

start time [15]=35

finish time [15]=41

start time [16]=56

finish time [16]=59

start time [17]=53

finish time [17]=56

start time [18]=41

finish time [18]=45

start time [19]=45

finish time [19]=46

start time [20]=59

finish time [20]=63

start time [21]=59

finish time [21]=63

start time [22]=46

finish time [22]=47

start time [23]=50

finish time [23]=56

start time [24]=63

finish time [24]=66

start time [25]=63

finish time [25]=66

## 3. 60 Aktivitas 3 tipe sumber daya

$$\begin{aligned} \text{Maks\_iterasi} &= 100 \\ \alpha &= 0.1 \\ m &= 10 \end{aligned}$$

## Populasi awal

## nilai prioritas tiap aktivitas ( 10 firefly )

## firefly ke- 1

0.525253 0.272727 0.40404 0.616162 0.545455 0.838384 0.252525 0.949495 0.747475 0.919192 0.858586 0.0909091  
 0.828283 0.767677 0.010101 0.59596 0.868687 0.808081 0.929293 0.040404 0.313131 0.0909091 0.686869 0.383838  
 0.828283 1 0.484848 0.323232 0.737374 0.565657 0.979798 0.222222 0.565657 0.171717 0.888889 0.535354 0.949495  
 0.040404 0.565657 0.292929 0.474747 0.151515 0.252525 0.59596 0.878788 0.676768 0.252525 0.666667 0.181818  
 0.575758 0.242424 0.848485 0.20202 0.222222 0.242424 0.969697 0.59596 0.151515 0.585859 0.949495

## firefly ke- 2

0.191919 0.191919 0.464646 0.616162 0.808081 0.717172 0.959596 0.20202 0.777778 0.727273 0.292929 0.979798 0.30303  
 0.141414 0.767677 0 0.656566 0.707071 0.616162 0.0707071 0.151515 0.565657 0.787879 0.656566 0.686869 0.929293  
 0.383838 0.050505 0.848485 0.757576 0.636364 0.69697 0.777778 0.575758 0.282828 0.40404 0.69697 0.515152 0.161616  
 0.818182 0.525253 0.515152 0 0.353535 0.414141 0.848485 0.717172 0.767677 0.232323 0.555556 0.737374 0.222222  
 0.333333 0.777778 0.282828 0.666667 0.747475 0.787879 0.575758 0.59596

## firefly ke- 3

0.525253 0.777778 0.444444 0.646465 0.676768 0.010101 0.30303 0.919192 0.818182 0.767677 0.313131 0.333333  
 0.878788 0.040404 0.787879 0.353535 0.313131 0.343434 0.767677 0.212121 0.151515 0.686869 0.030303 0.121212  
 0.949495 0.616162 0.949495 0.171717 0.121212 0.111111 0.949495 0.717172 0.515152 0.121212 0.292929 0.464646  
 0.939394 0.050505 0.010101 0.676768 0.020202 0.79798 0.050505 0.979798 0.969697 0.939394 0.838384 0.626263  
 0.656566 0.444444 0.050505 0.343434 0.414141 0.191919 0.545455 0.929293 0.030303 0.737374 0.424242 0.494949

## firefly ke- 4

0.343434 0.464646 0.151515 0.757576 0.616162 0.979798 0.808081 0.858586 0.989899 0.191919 1 0.232323 0.838384  
 0.969697 0.525253 0.434343 0.656566 0.717172 0.808081 0.515152 0.989899 0.434343 0.767677 0.858586 0.626263  
 0.868687 0 0.282828 0.646465 0.979798 0.272727 0.121212 0.737374 0.676768 0.50505 0.757576 0.69697 0.848485  
 0.575758 0.343434 0.585859 0.585859 0.10101 0.888889 0.161616 0.343434 0.0909091 0.333333 0.676768 0.444444  
 0.494949 0.0909091 0.676768 0.0707071 0.0909091 0.939394 0.0707071 0.636364 0.40404 0.020202

## firefly ke- 5

0.818182 0.868687 0.30303 0.020202 0.79798 0.383838 0.979798 0.0707071 0.343434 0.161616 0.393939 0.10101 0.282828  
 0.626263 0.565657 0.646465 0.969697 0.40404 0.474747 0.515152 0.535354 0.565657 0.989899 0.555556 0.878788  
 0.676768 0.212121 0.606061 0.020202 0.939394 0.525253 0.414141 0.262626 0.606061 0.282828 0.424242 0.949495  
 0.838384 0.272727 0.272727 0.191919 0.686869 0.010101 0.646465 0.111111 0.979798 0.50505 0.989899 0.222222  
 0.161616 0.515152 0.353535 0.757576 0.292929 0.131313 0.373737 0.565657 0.535354 0.272727 0.59596

## firefly ke- 6

0.565657 0.131313 0.747475 0.010101 0.171717 0.393939 0.484848 0.828283 0.020202 0.626263 0.939394 0.979798  
 0.616162 0.393939 0.383838 0.545455 0.020202 0.989899 0.666667 0.848485 0.929293 0.272727 0.040404 0.454545  
 0.575758 0.151515 0.323232 0.393939 0.333333 0.585859 0.040404 0.878788 0.989899 0.494949 0.646465 0.525253  
 0.121212 0.515152 0.30303 0.565657 0.767677 0.818182 0.565657 0.555556 0.727273 0.454545 0.727273 0.89899 0.393939  
 0.0909091 0.747475 0.878788 0.545455 0.282828 0.616162 0.434343 0.777778 0.121212 0.989899 0.0808081

## firefly ke- 7

0.0707071 0.464646 0.555556 0.767677 0.373737 0.919192 0.424242 0.606061 0.878788 0.818182 0.818182 0.555556  
 0.131313 0.232323 0.282828 0.222222 0.050505 0.454545 0.929293 0.747475 0.292929 0.808081 0.656566 0.757576  
 0.181818 0.363636 0.636364 0.89899 0.444444 0.161616 0.676768 0.030303 0.464646 0.484848 0.363636 0.969697 0.69697  
 0.989899 1 0.131313 0.878788 0.343434 0.050505 0.141414 0.363636 0.191919 0.313131 0.838384 0.0909091 0.373737  
 0.50505 0.858586 0.636364 0.787879 0.757576 0.525253 0.181818 0.454545 0.979798 0.545455

## firefly ke- 8

0.828283 0.737374 0 0.191919 0.323232 0.222222 0.878788 0.606061 0.89899 0.828283 0.939394 0.252525 0.888889  
 0.292929 0.636364 0.767677 0.747475 0.636364 0.010101 0.212121 0.666667 0.828283 0.171717 0.030303 0.828283  
 0.616162 0.232323 0.222222 0.050505 0.494949 0.89899 0.757576 0 0.353535 0.020202 0.878788 0.919192 0.252525  
 0.0808081 0.656566 0.10101 0.616162 0.646465 0.323232 0.858586 0.969697 0.40404 0.393939 0.292929 0.343434 0.10101  
 0.606061 0.292929 0.363636 0.0606061 0.606061 0.111111 0.525253 0.10101 0.151515

## firefly ke- 9

0.777778 0.111111 0.10101 0.515152 0.89899 0.515152 0.515152 0.666667 0.343434 0.050505 0.161616 0.777778 0.363636  
 0.878788 0.606061 0.191919 0.434343 0.252525 0.575758 0.0606061 0.929293 0.373737 0.747475 0.747475 0.949495  
 0.686869 0.969697 0.757576 0.626263 0.656566 0.767677 0.737374 0.0808081 0.181818 0.606061 0.515152 0.262626  
 0.858586 0.272727 0.292929 0.040404 0.636364 0.616162 0.010101 0.828283 0.30303 0.787879 1 0.050505 0.252525  
 0.69697 0.828283 0.949495 0.181818 0.121212 0.262626 0.909091 0.0808081 0.727273 0.141414

## firefly ke- 10



0.989899 0.171717 0.484848 0.393939 0.010101 0.89899 0.686869 0.656566 0.59596 0.313131 0.767677 0.727273 0.555556  
0.424242 0.030303 0.787879 0.636364 0.474747 0.151515 0.929293 0.131313 0.79798 0.010101 0.686869 0.020202 0.79798  
0.767677 0.646465 0.232323 0.656566 0.494949 0.090909 0.989899 0.868687 0.585859 0.666667 0.292929 0.424242  
0.545455 0.40404 0.484848 0.808081 0.878788 0.474747 0.393939 0.343434 0.474747 0.757576 0.040404 0.767677  
0.858586 0.090909 0.393939 0.010101 0.363636 0.010101 0.525253 0.434343 0.888889 0.484848

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## Iterasi 1

### firefly1

0.525253 0.272727 0.40404 0.616162 0.545455 0.838384 0.252525 0.949495 0.747475 0.919192 0.858586 0.090909  
0.828283 0.767677 0.010101 0.59596 0.868687 0.808081 0.929293 0.040404 0.313131 0.090909 0.686869 0.383838  
0.828283 1 0.484848 0.323232 0.737374 0.565657 0.979798 0.222222 0.565657 0.171717 0.888889 0.535354 0.949495  
0.040404 0.565657 0.292929 0.474747 0.151515 0.252525 0.59596 0.878788 0.676768 0.252525 0.666667 0.181818  
0.575758 0.242424 0.848485 0.20202 0.222222 0.242424 0.969697 0.59596 0.151515 0.585859 0.949495

### firefly2

0.162626 0.162626 0.435354 0.586869 0.778788 0.687879 0.930303 0.172727 0.748485 0.69798 0.263636 0.950505  
0.273737 0.112121 0.738384 0.020202 0.627273 0.677778 0.586869 0.041414 0.122222 0.536364 0.758586 0.627273  
0.657576 0.9 0.354545 0.021212 0.819192 0.728283 0.607071 0.667677 0.748485 0.546465 0.253535 0.374747 0.667677  
0.485859 0.132323 0.788889 0.49596 0.485859 0.020202 0.324242 0.384848 0.819192 0.687879 0.738384 0.20303 0.526263  
0.708081 0.192929 0.30404 0.748485 0.253535 0.637374 0.718182 0.758586 0.546465 0.59596

### firefly3

0.439394 0.691919 0.358586 0.560606 0.590909 0.089899 0.217172 0.833333 0.732323 0.681818 0.227273 0.247475  
0.792929 0.059596 0.70202 0.267677 0.227273 0.257576 0.681818 0.126263 0.065656 0.60101 0.069697 0.060606  
0.863636 0.530303 0.863636 0.085858 0.060606 0.070707 0.863636 0.631313 0.429293 0.060606 0.207071 0.378788  
0.853535 0.056565 0.089899 0.590909 0.079798 0.712121 0.056565 0.893939 0.883838 0.853535 0.752525 0.540404  
0.570707 0.358586 0.056565 0.257576 0.328283 0.106061 0.459596 0.843434 0.069697 0.651515 0.338384 0.494949

### firefly4

0.426263 0.547475 0.234343 0.840404 0.69899 1.06263 0.890909 0.941414 1.07273 0.274747 1.08283 0.315152 0.921212  
1.05253 0.608081 0.517172 0.739394 0.8 0.890909 0.59798 1.07273 0.517172 0.850505 0.941414 0.709091 0.951515  
0.0828283 0.365657 0.729293 1.06263 0.355556 0.20404 0.820202 0.759596 0.587879 0.840404 0.779798 0.931313  
0.658586 0.426263 0.668687 0.668687 0.183838 0.971717 0.244444 0.426263 0.173737 0.416162 0.759596 0.527273  
0.577778 0.173737 0.759596 0.153535 0.173737 1.02222 0.153535 0.719192 0.486869 0.020202

### firefly5

0.881313 0.931818 0.366162 0.083333 0.861111 0.44697 1.04293 0.133838 0.406566 0.224747 0.457071 0.164141 0.34596  
0.689394 0.628788 0.709596 1.03283 0.467172 0.537879 0.578283 0.598485 0.628788 1.05303 0.618687 0.941919 0.739899  
0.275253 0.669192 0.083333 1.00253 0.588384 0.477273 0.325758 0.669192 0.34596 0.487374 1.01263 0.901515 0.335859  
0.335859 0.25505 0.75 0.086363 0.709596 0.174242 1.04293 0.568182 1.05303 0.285354 0.224747 0.578283 0.416667  
0.820707 0.356061 0.194444 0.436869 0.628788 0.598485 0.335859 0.59596

### firefly6

0.575758 0.141414 0.757576 0.091919 0.181818 0.40404 0.49495 0.838384 0.081818 0.636364 0.949495 0.989899  
0.626263 0.40404 0.393939 0.555556 0.081818 1 0.676768 0.858586 0.939394 0.282828 0.061616 0.464646 0.585859  
0.161616 0.333333 0.40404 0.343434 0.59596 0.061616 0.888889 1 0.50505 0.656566 0.535354 0.131313 0.525253  
0.313131 0.575758 0.777778 0.828283 0.575758 0.565657 0.737374 0.464646 0.737374 0.909091 0.40404 0.10101 0.757576  
0.888889 0.555556 0.292929 0.626263 0.444444 0.787879 0.131313 1 0.0808081

### firefly7

0.10202 0.49596 0.586869 0.79899 0.405051 0.950505 0.455556 0.637374 0.910101 0.849495 0.849495 0.586869 0.162626  
0.263636 0.314141 0.253535 0.081818 0.485859 0.960606 0.778788 0.324242 0.839394 0.687879 0.788889 0.213131  
0.39495 0.667677 0.930303 0.475758 0.192929 0.708081 0.061616 0.49596 0.516162 0.39495 1.00101 0.728283 1.02121  
1.03131 0.162626 0.910101 0.374747 0.081818 0.172727 0.39495 0.223232 0.344444 0.869697 0.122222 0.405051  
0.536364 0.889899 0.667677 0.819192 0.788889 0.556566 0.213131 0.485859 1.01111 0.545455

### firefly8

0.791414 0.700505 0.036868 0.155051 0.286364 0.185354 0.841919 0.569192 0.862121 0.791414 0.902525 0.215657  
0.85202 0.256061 0.599495 0.730808 0.710606 0.599495 0.026767 0.175253 0.629798 0.791414 0.134848 0.00656566  
0.791414 0.579293 0.195455 0.185354 0.013636 0.458081 0.862121 0.720707 0.036868 0.316667 0.016667 0.841919  
0.882323 0.215657 0.043939 0.619697 0.064141 0.579293 0.609596 0.286364 0.821717 0.932828 0.367172 0.357071  
0.256061 0.306566 0.064141 0.569192 0.256061 0.326768 0.023737 0.569192 0.074242 0.488384 0.064141 0.151515

### firefly9

0.777778 0.111111 0.10101 0.515152 0.89899 0.515152 0.515152 0.666667 0.343434 0.050505 0.161616 0.777778 0.363636  
0.878788 0.606061 0.191919 0.434343 0.252525 0.575758 0.060606 0.929293 0.373737 0.747475 0.747475 0.949495  
0.686869 0.969697 0.757576 0.626263 0.656566 0.767677 0.737374 0.0808081 0.181818 0.606061 0.515152 0.262626

0.858586 0.272727 0.292929 0.040404 0.636364 0.616162 0.010101 0.828283 0.30303 0.787879 1 0.050505 0.252525  
 0.69697 0.828283 0.949495 0.181818 0.121212 0.262626 0.909091 0.0808081 0.727273 0.141414  
 firefly10  
 1.08737 0.269192 0.582323 0.491414 0.107576 0.996465 0.784343 0.75404 0.693434 0.410606 0.865152 0.824748 0.65303  
 0.521717 0.127778 0.885354 0.733838 0.572222 0.24899 1.02677 0.228788 0.895455 0.107576 0.784343 0.117677 0.895455  
 0.865152 0.743939 0.329798 0.75404 0.592424 0.188384 1.08737 0.966162 0.683333 0.764141 0.390404 0.521717 0.642929  
 0.501515 0.582323 0.905556 0.976263 0.572222 0.491414 0.440909 0.572222 0.855051 0.137879 0.865152 0.956061  
 0.188384 0.491414 0.107576 0.461111 0.107576 0.622727 0.531818 0.986364 0.484848

#### Populasi *Firefly* Terbaik (Iterasi 29)

firefly1  
 1.09646 0.932829 1.03283 1.23283 1.11768 1.41465 0.829798 1.52172 1.38333 1.53788 1.44091 0.682323 1.46717 1.42677  
 0.642929 1.20051 1.46212 1.45808 1.5096 0.667172 0.893435 0.657071 1.25303 1.01667 1.44899 1.58939 1.10556 0.903536  
 1.33687 1.22273 1.60657 0.828788 1.14293 0.815657 1.47121 1.16313 1.57323 0.64899 1.18737 0.94798 1.11061 0.75202  
 0.881313 1.16212 1.4803 1.31869 0.866162 1.29444 0.782323 1.16919 0.861111 1.44798 0.796465 0.788384 0.867172  
 1.57727 1.2096 0.739899 1.16212 0.918687  
 firefly2  
 0.336364 0.219192 0.350505 0.49798 0.631313 0.69899 0.849495 0.249495 0.60404 0.649495 0.185859 0.677777 0.277778  
 0.174747 0.660606 0.255556 0.334343 0.528283 0.452525 0.309091 0.191919 0.539394 0.630303 0.590909 0.746464  
 0.830303 0.247475 0.361616 0.693939 0.772727 0.491919 0.688889 0.659596 0.471717 0.281818 0.244444 0.646464  
 0.481818 0.223232 0.60202 0.375758 0.322222 0.235353 0.178788 0.275758 0.853535 0.628283 0.738384 0.211111  
 0.380808 0.606061 0.2 0.177778 0.49798 0.187879 0.458586 0.729293 0.880808 0.421212 0.758586  
 firefly3  
 0.316667 0.54798 0.340909 0.475252 0.458081 0.362121 0.334848 0.633838 0.665151 0.529798 0.320707 0.315657  
 0.685353 0.326768 0.496465 0.34596 0.325758 0.327778 0.501515 0.337879 0.35202 0.426768 0.325758 0.329798 0.743939  
 0.375252 0.691414 0.342929 0.315657 0.34596 0.787373 0.496464 0.35202 0.315657 0.322727 0.315657 0.675252 0.331818  
 0.325758 0.444949 0.342929 0.65707 0.327778 0.769192 0.742929 0.75303 0.658081 0.329798 0.403535 0.333838 0.328788  
 0.316667 0.328788 0.333838 0.332828 0.642929 0.343939 0.442929 0.324747 0.584343  
 firefly4  
 0.581313 0.604545 0.364141 1.0298 0.832828 1.05606 1.19646 1.08232 1.06414 0.369192 1.04596 0.400505 0.908586  
 1.13081 0.720707 0.709596 0.871212 0.860101 0.879293 0.658081 1.31263 0.689394 1.03687 1.10455 0.790404 1.13788  
 0.343939 0.472222 0.757071 1.37323 0.322727 0.231818 0.986364 0.798485 0.603535 0.867172 0.911616 0.999495  
 0.758081 0.538889 0.918687 0.833838 0.242929 1.14394 0.192424 0.463131 0.226768 0.64899 0.981313 0.715657 0.783333  
 0.182323 0.832828 0.191414 0.288384 1.12273 0.383333 0.879293 0.417677 0.0010101  
 firefly5  
 0.916162 1.10505 0.421212 0.30303 0.946464 0.579798 1.0798 0.223232 0.560606 0.378788 0.540404 0.090909 0.443434  
 0.755555 0.694949 0.792929 1.16566 0.539394 0.574748 0.670707 0.630303 0.608081 1.17374 0.639394 1.02626 0.886869  
 0.338384 0.775758 0.0959595 1.13838 0.631313 0.50303 0.317172 0.672727 0.381818 0.614141 1.11111 0.954545 0.377778  
 0.306061 0.384848 0.864647 0.286869 0.80606 0.326263 1.1202 0.641414 1.10909 0.328283 0.331313 0.664646 0.525253  
 1.02121 0.466667 0.254546 0.587879 0.779798 0.756566 0.432323 0.609091  
 firefly6  
 1.39192 0.957576 1.57374 0.908081 0.99798 1.2202 1.31111 1.65455 0.89798 1.45253 1.76566 1.80606 1.44242 1.2202  
 1.2101 1.37172 0.89798 1.81616 1.49293 1.67475 1.75556 1.09899 0.877778 1.28081 1.40202 0.977778 1.14949 1.2202  
 1.1596 1.41212 0.877778 1.70505 1.81616 1.32121 1.47273 1.35151 0.947475 1.34141 1.12929 1.39192 1.59394 1.64444  
 1.39192 1.38182 1.55354 1.28081 1.55354 1.72525 1.2202 0.917172 1.57374 1.70505 1.37172 1.10909 1.44242 1.26061  
 1.60404 0.947475 1.81616 0.0808081  
 firefly7  
 0.155556 0.527273 0.710101 0.849495 0.585859 1.05859 0.541414 0.827273 1.1101 0.988889 0.889899 0.808081 0.487879  
 0.39697 0.416162 0.471717 0.20101 0.710101 1.10606 1.09798 0.445455 0.833333 1.06465 0.941414 0.561616 0.673737  
 0.849495 0.976768 0.652525 0.356566 1.04545 0.154545 0.60101 0.629293 0.461616 1.15253 0.984848 1.1495 1.10404  
 0.318182 0.99899 0.530303 0.174747 0.450505 0.350505 0.319192 0.415152 0.875757 0.060606 0.520202 0.583838 1.07374  
 0.782828 1.13737 0.930303 0.742424 0.343434 0.549495 1.15253 0.675758  
 firefly8  
 0.961111 0.913637 0.308586 0.539899 0.525757 0.362121 1.0904 0.893435 1.09949 1.17828 1.27828 0.612626 1.20657  
 0.505555 0.888384 1.11263 1.03687 0.889394 0.441919 0.470202 1.03687 1.05808 0.374242 0.414646 1.11667 0.874243  
 0.568182 0.426768 0.296465 0.897475 1.08333 1.11061 0.35202 0.635858 0.486364 1.04394 1.15909 0.461111 0.338889  
 0.900505 0.402525 0.94596 0.924748 0.719697 1.12879 1.18333 0.682323 0.636869 0.54798 0.579293 0.421717 0.901515  
 0.625757 0.681313 0.327778 0.787374 0.373232 0.772222 0.432828 0.0505051  
 firefly9  
 1.03939 0.3 0.388889 0.848485 1.16061 0.451515 0.645455 0.712121 0.525253 0.320202 0.513131 0.959596 0.389899  
 1.11313 0.692929 0.569697 0.544444 0.544444 0.940404 0.325253 0.9 0.645455 0.844445 0.90101 1.02525 0.905051  
 1.18384 0.807071 0.886869 0.859596 0.869697 1.12424 0.450505 0.344444 0.892929 0.79697 0.411111 0.936364 0.413131

0.631313 0.20303 0.866667 1.01414 0.212121 1.04545 0.439394 1.02323 1.37475 0.214141 0.50606 0.770707 0.876768  
1.28081 0.290909 0.351515 0.458586 1.10303 0.307071 1.07475 0.365152  
firefly10  
1.21162 0.291414 0.460101 0.521717 0.317677 1.01869 0.855051 0.967172 0.584344 0.34899 1.08636 0.871212 0.75  
0.536869 0.0419192 0.911616 0.801515 0.566162 0.409596 1.17424 0.190404 1.01566 0.208586 0.902525 0.191414 0.94798  
0.942929 0.724748 0.341919 0.857071 0.54798 0.461111 1.13889 0.938889 0.710606 0.856061 0.500505 0.670202 0.717677  
0.671212 0.573232 0.95 1.14192 0.65 0.673232 0.575253 0.625758 1.0803 0.109596 1.11061 1.07626 0.24899 0.734848  
0.340909 0.519697 0.15303 0.800505 0.468182 1.15404 0.478788

Penjadwalan Firefly Terbaik Iterasi29

1 3 2 13 28 33 6 14 40 11 7 4 24 9 22 18 5 23 15 20 8 45 19 21 34 39 16 26 44 37 12 31 10 30 17 42 35  
43 49 27 50 41 25 36 32 48 57 46 59 38 47 51 52 53 29 54 55 56 60 58 dengan durasi : 82

Detail Start time dan Finish Time

start time [1]=0  
finish time [1]=8

start time [2]=0  
finish time [2]=1

start time [3]=0  
finish time [3]=10

start time [4]=10  
finish time [4]=16

start time [5]=16  
finish time [5]=21

start time [6]=8  
finish time [6]=16

start time [7]=10  
finish time [7]=19

start time [8]=19  
finish time [8]=20

start time [9]=13  
finish time [9]=22

start time [10]=28  
finish time [10]=36

start time [11]=10  
finish time [11]=13

start time [12]=25  
finish time [12]=31

start time [13]=1  
finish time [13]=3

start time [14]=8  
finish time [14]=13

start time [15]=16  
finish time [15]=17

start time [16]=21  
finish time [16]=24

start time [17]=31  
finish time [17]=41

start time [18]=16  
finish time [18]=25

start time [19]=19  
finish time [19]=20

start time [20]=19  
finish time [20]=22

start time [21]=19  
finish time [21]=25

start time [22]=16  
finish time [22]=19

start time [23]=16  
finish time [23]=19

start time [24]=13  
finish time [24]=20

start time [25]=43  
finish time [25]=49

start time [26]=22  
finish time [26]=42

start time [27]=41  
finish time [27]=50

start time [28]=1  
finish time [28]=9

start time [29]=63  
finish time [29]=67

start time [30]=31  
finish time [30]=34

start time [31]=28  
finish time [31]=31

start time [32]=47  
finish time [32]=53

start time [33]=3  
finish time [33]=4

start time [34]=20  
finish time [34]=29

start time [35]=34  
finish time [35]=43

start time [36]=46  
finish time [36]=47

start time [37]=24  
finish time [37]=26

start time [38]=53  
finish time [38]=57

start time [39]=20  
finish time [39]=29

start time [40]=9  
finish time [40]=19

start time [41]=43  
finish time [41]=51

start time [42]=34  
finish time [42]=38

start time [43]=36  
finish time [43]=39

start time [44]=22  
finish time [44]=28

start time [45]=19  
finish time [45]=25

start time [46]=50  
finish time [46]=57

start time [47]=53  
finish time [47]=56

start time [48]=49  
finish time [48]=51

start time [49]=39  
finish time [49]=49

start time [50]=42  
finish time [50]=46

start time [51]=57  
finish time [51]=59

start time [52]=57  
finish time [52]=58

start time [53]=59  
finish time [53]=63

start time [54]=63  
finish time [54]=73

start time [55]=67  
finish time [55]=75

start time [56]=73  
finish time [56]=79

start time [57]=49  
finish time [57]=59

start time [58]=79  
finish time [58]=82

start time [59]=51  
finish time [59]=61

start time [60]=75  
finish time [60]=76

### Lampiran 6 : Antar Muka Program

```
G:\modifikasi firefly.exe  
-----  
PROGRAM RCPSP Dengan Algoritma Firefly  
-----  
Masukkan banyaknya firefly (2-1000):  
10  
Masukkan banyaknya iterasi (1-1000) :  
100  
Masukkan koefisien parameter random(alpha):(0-1)  
0.1
```

```
G:\modifikasi firefly.exe  
Pilihan Data RCPSP :  
1. Pilihan Data Kecil  
2. Pilihan Data Sedang  
3. Pilihan Data Besar  
Masukkan Pilihan Data :  
1
```

```
G:\modifikasi firefly.exe  
Hasil Akhir Running Program RPCSP :  
Penjadwalan Firefly Terbaik :3 1 2 6 5 9 8 10 7 4  
dengan durasi :  
27
```