LAMPIRAN

LAMPIRAN I

LISTING PROGRAM

```pascal
Program Knapsack;
Uses crt;
type VekReal = array [1..1000] of real;
     VekByte = array [1..1000] of byte;
var jmlobjek,j,i,k,s : integer;
    MaksBobot,PBest,p,z : real;
    Profit,Bobot : VekReal;
    XBest,X : VekByte;
    lagi,KeStep4 : boolean;
    pilih : char;


Procedure JendelaUtama;
var Jdl1,Jdl2,Jdl3,Jdl4,Jdl5,Jdl6,Jdl7 : string;
    j1 : word;
begin
    ClrScr;
    TextBackground(Blue);
    TextColor(Yellow);
    gotoxy(10,1);write('╔');
    j1:=11;
    repeat
        gotoxy(j1,1);write('=');
        inc(j1);
    until j1 = 70;
    gotoxy(70,1);write('╗');
    j1:=2;
    repeat
        gotoxy(10,j1);write('║');
        gotoxy(11,j1);write('':59);
        gotoxy(70,j1);write('║');
        inc(j1);
    until j1=22;
    gotoxy(10,22);write('╚');
    j1:=11;
    repeat
        gotoxy(j1,22);write('=');
        inc(j1);
    until j1 = 70;
```

```pascal
gotoxy(70,22);write('╝');
TextColor(yellow);
Jdl1 := 'IMPLEMENTASI ALGORITMA BRANCH AND BOUND';
Jdl2 := 'OLEH HOROWITZ-SAHNI UNTUK PENYELESAIAN';
Jdl3 := 'MASALAH KNAPSACK';
Jdl4 := 'ALGORITMA BRANCH AND BOUND HOROWTIZSAHNI';
Jdl3 := '══════════════════════════════════════';
Jdl5 := ' NAMA    : SANTY RAHMAWATI';
Jdl6 := ' NIM     : J2A 098 049';
Jdl7 := ' JURUSAN : MATEMATIKA';
gotoxy((80-length(jdl1)) div 2,2);write(Jdl1);
gotoxy((80-length(jdl2)) div 2,3);write(Jdl2);
gotoxy((90-length(jdl3)) div 2,4);write(Jdl3);
gotoxy((80-length(jdl4)) div 2,5);write(Jdl4);
gotoxy((80-length(jdl5)) div 2,6);write(Jdl5);
gotoxy((76-length(jdl6)) div 2,7);write(Jdl6);
gotoxy((74-length(jdl7)) div 2,8);write(Jdl7);
TextColor(blue);
TextBackGround(magenta);
gotoxy(15,10);write('╔');
j1:=16;
repeat
    gotoxy(j1,10);write('═');
    inc(j1);
until j1 = 65;
gotoxy(65,10);write('╗');
j1:=11;
repeat
    gotoxy(15,j1);write('║');
    gotoxy(65,j1);write('║');
    gotoxy(16,j1);write('':49);
    inc(j1);
until j1=20;
gotoxy(15,20);write('╚');
j1:=16;
repeat
    gotoxy(j1,20);write('═');
    inc(j1);
until j1 = 65;
gotoxy(65,20);write('╝');
TextColor(white);
Jdl1:='MENU UTAMA';
Jdl2:='════════════';
gotoxy(15+(50-length(Jdl1)) div 2, 11);write(Jdl1);
gotoxy(15+(50-length(Jdl2)) div 2, 12);write(Jdl2);
gotoxy(31,13);write('1. Pengisian Data');
gotoxy(31,14);write('2. Proses');
```

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        gotoxy(31,15);write('3. Lihat Hasil');
        gotoxy(31,16);write('4. Keluar');
        gotoxy(31,18);write('Pilih salah satu : ');
        TextBackGround(black);
end;

Procedure Pesan(Jdl1:string; lama:word);
var j1 : word;
begin
     TextBackGround(red);
     TextColor(cyan);
     gotoxy(20,13);write('┌');
     j1:=21;
     repeat
        gotoxy(j1,13);write('─');
        inc(j1);
     until j1=60;
     gotoxy(60,13);write('┐');
     j1:=14;
     repeat
        gotoxy(20,j1);write('│');
        gotoxy(60,j1);write('│');
        gotoxy(21,j1);write('':39);
        inc(j1);
     until j1=17;
     gotoxy(20,17);write('└');
     j1:=21;
     repeat
        gotoxy(j1,17);write('─');
        inc(j1);
     until j1=60;
     gotoxy(60,17);write('┘');
     TextColor(white+blink);
     gotoxy(20+(40-length(Jdl1)) div 2,15);write(Jdl1);
     delay(lama);
     TextBackground(Black);
     TextColor(white);
  end;


Procedure Pesan1(Jdl1:string; lama:word);
var j1 : word;
begin
     TextBackGround(red);
     TextColor(cyan);
     gotoxy(25,13);write('┌');
     j1:=26;
```

```pascal
      repeat
        gotoxy(j1,13);write('─');
        inc(j1);
      until j1=55;
      gotoxy(55,13);write('┐');
      j1:=14;
      repeat
        gotoxy(25,j1);write('│');
        gotoxy(55,j1);write('│');
        gotoxy(26,j1);write('':29);
        inc(j1);
      until j1=17;
      gotoxy(25,17);write('└');
      j1:=26;
      repeat
        gotoxy(j1,17);write('─');
        inc(j1);
      until j1=55;
      gotoxy(55,17);write('┘');
      TextColor(white+blink);
      gotoxy(25+(30-length(Jdl1)) div 2,15);write(Jdl1);
      delay(lama);
      TextBackground(Black);
      TextColor(white);
end;

Procedure IsiData;
var btsbrs,l,m,j1,j2 : integer;
    Jdl1,Jdl2,namafile : string;
    jawab,plh : char;
    f : text;

    Procedure Kotak1;
    begin
        gotoxy(20,11);write('╔');
        j1:=21;
        repeat
          gotoxy(j1,11);write('=');
          inc(j1);
        until j1 = 60;
        gotoxy(60,11);write('╗');
        j1:=12;
        repeat
          gotoxy(20,j1);write('║');
          gotoxy(60,j1);write('║');
          gotoxy(21,j1);write('':39);
          inc(j1);
```

```pascal
    until j1=18;
    gotoxy(20,18);write('╚');
    j1:=21;
    repeat
       gotoxy(j1,18);write('=');
       inc(j1);
    until j1 = 60;
    gotoxy(60,18);write('╝');
end;

Procedure Kotak2;
var j5:word;
begin
    ClrScr;
    TextBackGround(red);
    gotoxy(15,1);write('╔');
    j5:=16;
    repeat
       gotoxy(j5,1);write('=');
       inc(j5);
    until j5 = 65;
    gotoxy(65,1);write('╗');
    j5:=2;
    repeat
       gotoxy(15,j5);write('║');
       gotoxy(65,j5);write('║');
       gotoxy(16,j5);write('':49);
       inc(j5);
    until j5=23;
    gotoxy(15,23);write('╚');
    j5:=16;
    repeat
       gotoxy(j5,23);write('=');
       inc(j5);
    until j5 = 65;
    gotoxy(65,23);write('╝');

    Jdl1:='ISI DATA TIAP ITEM';
    Jdl2:='══════════════════';
    gotoxy((80-length(jdl1)) div 2,2);
    write(Jdl1);
    gotoxy((80-length(jdl2)) div 2,3);
    write(Jdl2);
    TextBackGround(Blue);
    gotoxy(20,5);write('╔');
    j5:=21;
    repeat
```

```pascal
                        gotoxy(j5,5);write('=');
                        inc(j5);
                  until j5 = 60;
                  gotoxy(60,5);write('╗');
                  j5:=6;
                  repeat
                     gotoxy(20,j5);write('║');
                     gotoxy(60,j5);write('║');
                     gotoxy(21,j5);write('':39);
                     inc(j5);
                  until j5=21;
                  gotoxy(20,6);write('║');
                  gotoxy(25,6);write('Item');
                  gotoxy(37,6);write('Profit');
                  gotoxy(50,6);write('Bobot');
                  gotoxy(60,6);write('║');
                  gotoxy(20,7);write('╠');
                  j5:=21;
                  repeat
                     gotoxy(j5,7);write('=');
                     inc(j5);
                  until j5 = 60;
                  gotoxy(60,7);write('╣');
                  gotoxy(20,21);write('╚');
                  j5:=21;
                  repeat
                     gotoxy(j5,21);write('=');
                     inc(j5);
                  until j5 = 60;
                  gotoxy(60,21);write('╝');
               end;

      begin
            repeat
               TextColor(yellow);
               TextBackGround(blue);
               Kotak1;
               Jdl1 := 'PENGISIAN DATA';
               jdl2 := '═══════════════';
               gotoxy(20+(40-length(Jdl1)) div 2, 12);
               write(Jdl1);
               gotoxy(20+(40-length(Jdl2)) div 2, 13);
               write(Jdl2);
               gotoxy(31,14);write('1. Dari File');
               gotoxy(31,15);write('2. Dari Keyboard');
               TextColor(white);
               Jdl1:='Pilih atau Tekan ESCape ';
```

```pascal
gotoxy(20+(40-length(Jdl1)) div 2, 17);
write(Jdl1);
plh:=readkey;
TextColor(yellow);
case plh of
      '1' : begin
              Kotak1;
              Jdl1 := 'ISI DATA DARI FILE';
              jdl2 := '========================';
              gotoxy(20+(40-length(Jdl1))div2,12);
              write(Jdl1);
              gotoxy(20+(40-length(Jdl2))div2,13);
              write(Jdl2);
              gotoxy(25,15);write('Masukkan nama
              file : ');
              TextColor(white);
              gotoxy(25,16);readln(namafile);
              assign(f,namafile);
              {$I-}
              reset(f);
              {$I+}
              if IOResult <> 0 then
                  pesan1('FILE TIDAK ADA',3000)
              else
              begin
                  readln(f,jmlobjek);
                  readln(f,MaksBobot);
                  for j1:=1 to jmlobjek do
                  readln(f,profit[j1],bobot[j1]);
                  Close(f);
              end;
            end;
      '2' : begin
              Kotak1;
              Jdl1 := 'ISI DATA DARI KEYBOARD';
              jdl2 := '==========================';
              gotoxy(20+(40-length(Jdl1))div2,12);
              write(Jdl1);
              gotoxy(20+(40-length(Jdl2))div2,13);
              write(Jdl2);
              Gotoxy(25,15);write('Masukkan jumlah
              objek: ');
              readln(jmlobjek);
              Gotoxy(25,16);write('Maksimal
              bobotknapsack:');
              readln(MaksBobot);
              TextBackground(black);
```

```pascal
                        repeat
                            Kotak2;
                            l:=8;
                            for j1:=1 to jmlobjek do
                            begin
                              TextColor(white);
                              gotoxy(26,l);write(j1:2);
                              gotoxy(37,l);readln(Profit[j1]);
                              gotoxy(50,l);readln(Bobot[j1]);
                                inc(l);
                                if l mod 21 = 0 then
                                begin
                                    TextbackGround(Black);
                                    Kotak2;
                                    l:=8;
                                end;
                            end;
                            TextbackGround(Black);
                            gotoxy(20,24);
                            write('Apakah sudah benar
                            (y/t) ? ');
                            readln(jawab);
                        until jawab in ['y','Y'];
                        plh := #27;
                    end;
            end;
        until plh = #27;
end;

Procedure Inisialisasi;
var j1,j2:integer;
    Rasio:VekReal;
    temp:real;
begin
    for j1:=1 to jmlobjek do
        rasio[j1]:=profit[j1]/bobot[j1];
    PBest:=0; p:=0; i:=1; k:=1;
    for j1:=1 to jmlobjek do
    begin
        XBest[j1]:=0; X[j1]:=0;
    end;
    Profit[jmlobjek+1]:=0;
    Bobot[jmlobjek+1]:=100000;
    for j1:=1 to jmlobjek-1 do
        for j2:=1 to jmlobjek-1 do
            if rasio[j2] < rasio[j2+1] then
                begin
```

```
                        temp:=rasio[j2]; rasio[j2]:=rasio[j2+1];
                   rasio[j2+1]:=temp;
                     temp:=profit[j2];
                   profit[j2]:=profit[j2+1];
                   profit[j2+1]:=temp;
                      temp:=bobot[j2]; bobot[j2]:=bobot[j2+1];
                   bobot[j2+1]:=temp;
                 end;
        end;

        Procedure CariS(i1:integer; var s1:integer);
        var JmlW:real;
        begin
           if Bobot[i] > MaksBobot then
                s1:=i1-1
           else
           begin
              JmlW:=Bobot[i];
              repeat
                 s1:=i1;
                 i1:=i1+1;
                 jmlW:=JmlW+Bobot[i1];
              until JmlW > MaksBobot;
           end;
        end;

        Procedure HitungZ;
        var JmlProfit,JmlBobot:real;
             j1:integer;
        begin
            JmlProfit:=0; JmlBobot:=0;
            if i <= s then
                for j1:=i to s do
                begin
                    jmlProfit:=jmlProfit+Profit[j1];
                    jmlBobot:=JmlBobot+Bobot[j1];
                end;
            z:=JmlProfit+(MaksBobot-
        JmlBobot)*Profit[s+1]/Bobot[s+1];
            end;

        procedure BuildSolution;
        begin
            repeat
               if Bobot [i] <= MaksBobot then
               begin
                    MaksBobot:=MaksBobot-Bobot[i];
```

```pascal
                p:=p+Profit[i];
                X[i]:=1;
                i:=i+1;
                if i<=jmlObjek then
                    lagi:=true
                else
                begin
                    lagi:=false; KeStep4:=true;
                end;
        end
        else
        begin
                X[i]:=0;
                i:=i+1;
                if i=jmlobjek then
                    lagi:=true
                else
                begin
                    lagi:=false;
                    if i>jmlobjek then KeStep4:=true;
                end;
        end;
    until lagi=false;
end;

Procedure UpdateSolution;
begin
  if PBest<p then
  begin
      PBest:=p;
      for j:=1 to jmlobjek do
          XBest[j]:=X[j];
  end;
  i:=jmlobjek;
  if X[jmlobjek]=1 then
  begin
      MaksBobot:=MaksBobot+Bobot[jmlobjek];
      p:=p-Profit[jmlobjek];
      X[jmlobjek]:=0;
  end;
end;

Procedure BackTrack;
var j1:integer;
begin
    k:=0;
    for j1:=1 to i-1 do
```

```pascal
            if (X[j1]=1) and (k<j1) then
                k:=j1;
        if k <> 0 then
        begin
            MaksBobot:=MaksBobot+Bobot[k];
            p:=p-Profit[k];
            X[k]:=0;
            i:=k+1;
        end;
end;

Procedure Cetak;
var Jdl1,Jdl2 : string;
    j1,l,m : integer;
    TotalBobot:real;

    Procedure Kotak;
    var j5:word;
    begin
        ClrScr;
        TextBackGround(red);
        TextColor(yellow);
        gotoxy(15,1);write('╔');
        j5:=16;
        repeat
            gotoxy(j5,1);write('=');
            inc(j5);
        until j5 = 65;
        gotoxy(65,1);write('╗');
        j5:=2;
        repeat
            gotoxy(15,j5);write('║');
            gotoxy(65,j5);write('║');
            gotoxy(16,j5);write('':49);
            inc(j5);
        until j5=24;
        gotoxy(15,24);write('╚');
        j5:=16;
        repeat
            gotoxy(j5,24);write('=');
            inc(j5);
        until j5 = 65;
        gotoxy(65,24);write('╝');

        Jdl1 := 'HASIL PENYELESAIAN';
        Jdl2 := '═══════════════════';
        gotoxy((80-length(jdl1)) div 2,2);write(Jdl1);
```

```pascal
gotoxy((80-length(jdl2)) div 2,3);write(Jdl2);
TextbackGround(blue);
TextColor(white);
gotoxy(20,4);write('╔');
j5:=21;
repeat
    gotoxy(j5,4);write('=');
    inc(j5);
until j5 = 60;
gotoxy(60,4);write('╗');
j5:=5;
repeat
    gotoxy(20,j5);write('║');
    gotoxy(60,j5);write('║');
    gotoxy(21,j5);write('':39);
    inc(j5);
until j5=23;
gotoxy(20,5);write('║');

gotoxy(23,5);write('Item');
gotoxy(32,5);write('Profit');
gotoxy(43,5);write('Bobot');
gotoxy(53,5);write('X (i)');

gotoxy(60,5);write('║');
gotoxy(20,6);write('╟');
j5:=21;
repeat
    gotoxy(j5,6);write('=');
    inc(j5);
until j5 = 60;
gotoxy(60,6);write('╢');
gotoxy(20,20);write('╟');
j5:=21;
repeat
    gotoxy(j5,20);write('=');
    inc(j5);
until j5 = 60;
gotoxy(60,20);write('╢');
gotoxy(20,23);write('╚');
j5:=21;
repeat
gotoxy(j5,23);write('=');
    inc(j5);
    until j5 = 60;
    gotoxy(60,23);write('╝');
end;
```

```
begin
    TotalBobot:=0;
    for j1:=1 to jmlobjek do
        TotalBobot:=TotalBobot+Bobot[j1]*XBest[j1];

    Kotak;
    l:=7;
    for j1:=1 to jmlobjek do
    begin
        TextColor(white);
        gotoxy(33,l); write(Profit[j1]:4:0);
        gotoxy(44,l); write(Bobot[j1]:3:0);
        if XBest[j1] = 1 then TextColor(Yellow);
        gotoxy(24,l); write(j1:2);
        if XBest[j1] = 1 then TextColor(LightRed);
        gotoxy(55,l); write(XBest[j1]:1);
        inc(l);
        if l mod 20 = 0 then
        begin
            gotoxy(22,22);write('Tekan ENTER ... ');
            readkey;
            TextBackGround(Black);
            Kotak;
            l:=7;
        end;
    end;
    TextColor(white);
    gotoxy(22,21);write('Total Bobot             :');
    gotoxy(22,22);write('Profit yang diperoleh :');
    TextColor(Yellow);
    gotoxy(53,21);write(TotalBobot:5:0);
    gotoxy(53,22);write(PBest:5:0);
    readkey;
end;


BEGIN
  repeat
    TextBackGround(Black);
    JendelaUtama;
    pilih:=readkey;
    case pilih of
            '1' : begin
                      IsiData;

                  end;
```

```pascal
        '2' : begin
                if (JmlObjek = 0) or (MaksBobot = 0 )then
                    Pesan('ISIKAN DATA TERLEBIH DULU',3000)
                else
                begin
                    Inisialisasi;
                    repeat
                        CariS(i,s);
                        HitungZ;
                        if PBest < (trunc(z)+p) then
                        begin
                            KeStep4:=false;
                            BuildSolution;
                            if KeStep4=true then
                            begin
                                UpdateSolution;
                                BackTrack;
                            end;
                        end
                        else
                            BackTrack;
                    until k=0;
                    Pesan('TUNGGU, DATA SEDANG DIPROSES
                    .... ',5000);
                end;
            end;
        '3' : begin
                if PBest = 0 then
                    Pesan('BELUM ADA HASIL YANG DIPEROLEH
                    ',3000)
                else
                    Cetak;
            end;
    end;
    TextBackGround(Black);
  until (pilih = '4') or (pilih = #27);
END.
```

LAMPIRAN II

OUTPUT PROGRAM
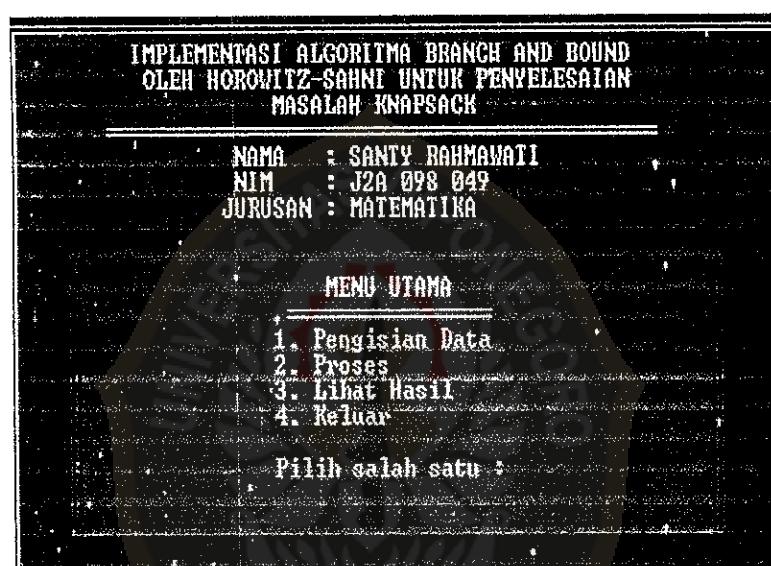
<< Tampilan Menu Utama >>
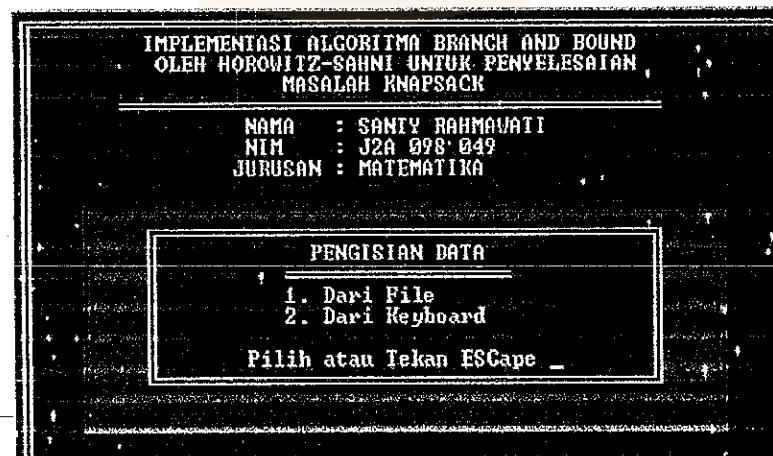
<< Tampilan Pengisian Data >>
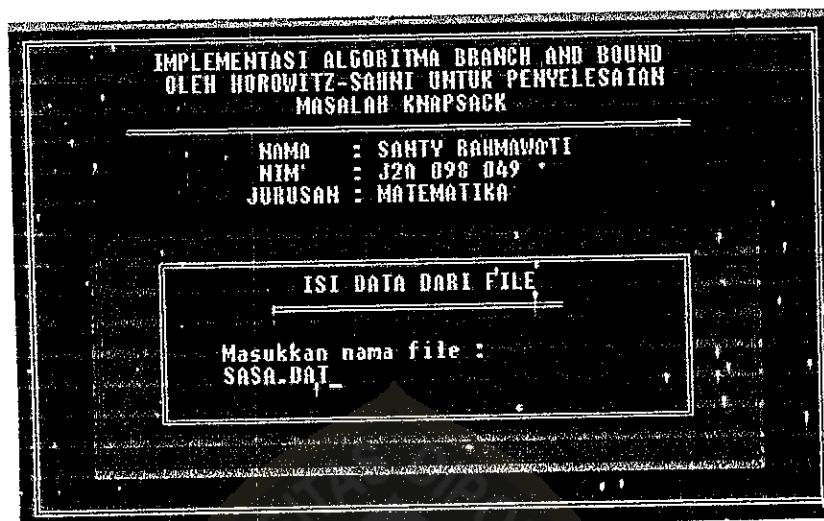
<< Tampilan Masukan Nama File >>

<< Tampilan Pemprosesan Data >>

```
                  HASIL PENYELESAIAN

   Item       Profit        Bobot       X (i)

    1           179           73           1
    2           144           59           1
    3           182           80           1
    4           186           90           1
    5            50           25           1
    6           176           91           1
    7           181           99           1
    8           140           77           1
    9            78           43           1
   10           171          105           1
   11            48           30           0
   12            80           50           1
   13           156           98           1


   Tekan ENTER ...
```

<< Tampilan Hasil Penyelesaian >>

```
                  HASIL PENYELESAIAN

   Item       Profit        Bobot       X (i)

   14           199          131           0
   15            75           50           1
   16            87           58           1
   17            97           69           0
   18           170          130           0
   19           110           85           0
   20            45           35           0
   21           185          150           0
   22            90           78           0
   23            97           85           0
   24            75           66           0
   25           150          135           0
   26            95           87           0


   Tekan ENTER ...
```

<< Tampilan Hasil Penyelesaian >>

```
                    HASIL PENYELESAIAN

      Item        Profit         Bobot         X (i)
       27           85             81             0
       28           68             65             0
       29          100             96             0
       30           88             85             0
       31          150            145             0
       32          100             98             0
       33           79             80             0
       34           69             70             0
       35           75             79             0
       36           85             90             0
       37           61             65             0
       38           75             80             0
       39          117            125             0

     Tekan ENTER ... _
```

<< Tampilan Hasil Penyelesaian >>

```
                    HASIL PENYELESAIAN

      Item        Profit         Bobot         X (i)
       40           58             62             0
       41           93            100             0
       42           55             60             0
       43          155            170             0
       44           63             70             0
       45           82             92             0
       46          132            150             0
       47           52             60             0
       48           68             79             0
       49           94            113             0
       50           74             90             0
       51           59             73             0
       52           99            125             0

     Tekan ENTER ... _
```

<< Tampilan Hasil Penyelesaian >>

```
                  HASIL PENYELESAIAN

    Item         Profit          Bobot          X (i)

    53           140             180            0
    54           65              89             0
    55           43              60             0
    56           88              130            0
    57           55              85             0
    58           60              96             0
    59           70              114            0
    60           54              90             0
    61           75              130            0
    62           92              160            0
    63           97              180            0
    64           57              113            0
    65           78              155            0


 Tekan ENTER ...
```

<< Tampilan Hasil Penyelesaian >>

```
                  HASIL PENYELESAIAN

    Item         Profit          Bobot          X (i)

    66           45              90             0
    67           90              200            0
    68           76              176            0
    69           53              140            0
    70           60              250            0











 Total Bobot                    :              998
 Profit yang diperoleh :                       1885
```

<< Tampilan Hasil Penyelesaian >>