البرمجة الإجرائية

Lecture No. 8

Flow control examples

CPU time

Cell vs. Structure Arrays

ميكاترونيك-سنة أولى-فصل أول

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Examples

```
x= input('input val:');
while(1)
  units = input('input units:');
  switch units
    case {'inch','in'}
       y=x*2.54;
    case {'feet','ft'}
       y=x*2.54*12;
    case {'mm', 'melimeter'}
       y=x/10;
    case {'m', 'meter'}
       y=x*100;
     otherwise
       disp('unknowns')
       continue
  end
disp([num2str(y) 'cm'])
break
end
```

اكتب برنامج لتحويل واحدات الطول إلى cm

1 in = 2.54 cm

1 ft = 12 in=12*2.54 cm =30.48cm

1 m = 100 cm

1 mm = 0.1 cm

```
>> lec8_1
input val:1
input units:'in'
2.54cm
```

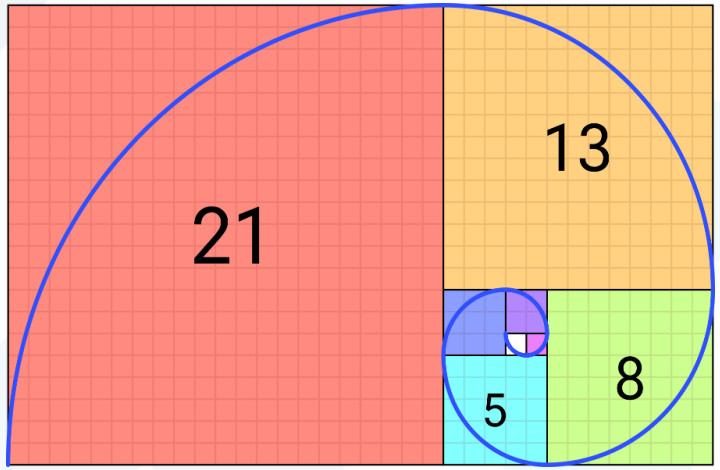
أعداد فيبوناتشي Examples Fibonacci numbers

اكتب برنامج لحساب أول x حد من سلسلة fibonacci

```
clc;clear
x=input('input max limit');
for n=1:x
  if n==1 | n==2
    result(n)=1;
  else
    result(n)=result(n-1)+result(n-2);
  end
end
disp(result)
```

F(1)=F(2)=1

F(n)=F(n-1)+F(n-2)



لاحظ طول ضلع المربع

لولب فيبوناتشي:

an approximation of the golden spiral created by drawing circular arcs connecting the opposite corners of squares in the Fibonacci tiling

النسبة الذهبية، قسمة كل عدد من المتتالية على العدد الذي يسبقه

يُلاحظ الاقتراب شيئا فشيئا من الرقم 1.618034 الذي يسمى الرقم الذهبي نظرا لخصائصه العجيبة في الرياضيات كما في الطبيعة.

أعداد فيبوناتشي Examples Fibonacci numbers

```
clc;clear
x=input('input max limit');
result=zeros(1,x);
for n=1:x
  if n==1 || n==2
     result(n)=1;
  else
     result(n)=result(n-1)+result(n-2);
  end
end
disp(result)
```

تسريع التنفيذ بحجز الشعاع result مسبقا

```
clc;clear
x=input('input max limit');
result=ones(1,x);
for n=3:x
     result(n)=result(n-1)+result(n-2);
end
disp(result)
```

Measure Elapsed Time

tic: Start a stopwatch timer.

toc: Read the stopwatch timer.

cputime: returns the CPU time in seconds that has been used by the MATLAB process since MATLAB started. The return value may overflow the internal representation and wrap around.

clock Current date and time as date vector.

```
t=cputime;
your_operation;
cputime-t
```

```
>> tic
toc
Elapsed time is 0.454591 seconds.
>>
```

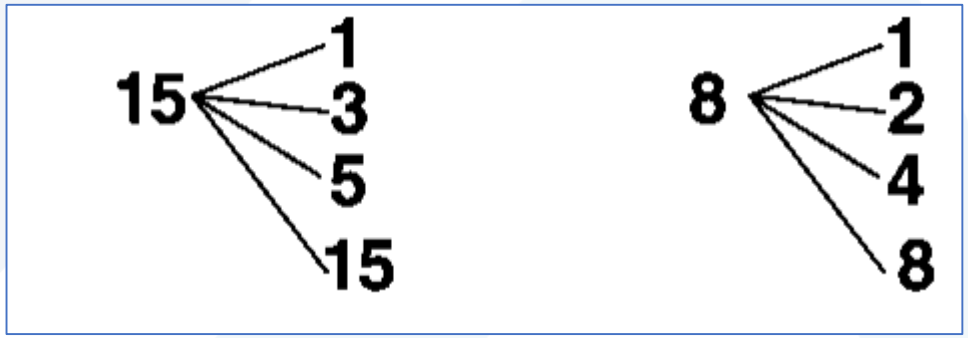
Co-prime numbers

- A prime number is a number that has exactly two factors, 1 and the number itself. For example, 2, 3, 7, 11 and so on are prime numbers.
- Co-prime numbers الأعداد الأولية المشتركة أو الأعداد الأولية نسبيًا are pairs of numbers whose HCF (Highest Common Factor) or greatest common divisor (GCD) is 1. For example, (15,8) are co-primes because their only common factor is 1.

```
gcd(9,18)
ans =
    9
```

```
gcd(15,8)
ans =
    1
```

factors of 15 and 8:



Co-prime numbers

GCD_LCM.m

```
x=input('Enter the first number:');
y=input('Enter the second number:');
for i=1:min(x,y)
    if(rem(x,i)==0 && rem(y,i)==0)
        c=i;
    end
end
z=(x*y)/c;
disp('GCD=');
disp(c);
disp('LCM=');
disp(z);
if(c == 1)
    disp('coprime')
else
    disp('not coprime')
end
```

```
>> GCD_LCM
Enter the first number:5
Enter the second number:6
GCD=
   1

LCM=
   30

coprime
```

rem(x,y) and mod(x,y) are equal if x and y have the same sign, but differ by y if x and y have different signs.

- Note: REM(x,y), for x~=y and y~=0, has the same sign as x.
- Note: MOD(x,y), for x~=y and y~=0, has the same sign as y.

Prime numbers

isprime True for prime numbers.

isprime(X) is 1 for the elements of X that are prime, 0 otherwise.

```
>> isprime(2)
ans =
  logical
   1
```

```
>> isprime(4)
ans =
  logical
   0
```

```
>> isprime(100)
ans =
  logical
   0
```

```
>> isprime(1)
ans =
  logical
   0
```

p = primes(n) returns a row vector of the prime numbers less than or equal to n .

```
>> primes(30)
ans =
    2    3    5    7   11   13   17   19   23   29
```

Collatz Conjecture

- The **Collatz conjecture** (named after Lothar Collatz) is an unsolved conjecture in mathematics. This conjecture is also known as 3n + 1.
- the sequence of numbers involved is referred to as the **hailstone sequence** (because values typically **rise and fall**).
- This is the sequence: take a positive integer *n*; if *n* is even, divide it by 2, and that's the next number in the sequence; if *n* is odd, the next number is 3*n* + 1.
- Repeat the process indefinitely… or until you reach 1.

If n_i even, then $n_{i+1}=n_i/2$

If n_i odd, then $n_{i+1}=3\ n_i+1$

Collatz Conjecture

```
clc
clear
n=input("pls input a
number:");
seq(1) = n;
i = 2;
```

```
while seq(i-1) ~= 1
    if mod(seq(i-1), 2) == 0
        % Step taken if even
        seq(i) = seq(i-1)/2;
    else
        % Step taken if odd
        seq(i) = 3*seq(i-1) + 1;
    end
    % Increment your index
    i = i+1;
end
```

```
% Find the length of
the sequence
ns = length(seq)
disp(seq)
```

Collatz Conjecture

```
pls input a number:21
ns =
     8
  21  64  32  16   8   4   2   1
```

```
pls inpiut a number:15
ns =
    18

  Columns 1 through 17
  15  46  23  70  35  106  53  160  80  40  20  10   5  16   8   4   2
  Column 18
   1
```

Cell vs. Structure Arrays

- **A structure array is a data type that groups related data using data containers called fields**. Each field can contain any type of data.

- A cell array is a data type with indexed data containers called cells, where each cell can contain any type of data.

- Cell arrays commonly contain either lists of text, combinations of text and numbers, or numeric arrays of different sizes.
- **A cell array may contain any arbitrary type of element in each cell;**
- **while a matrix requires the types of its elements to be homogeneous i.e. of the same type**.

- Both cell and structure **arrays allow you to store data of different types and sizes**.
- **C = struct2cell(S)** converts a structure into a cell array. The cell array C contains values copied from the fields of S

Cell vs. Structure Arrays

Cell Arrays

```
temperature(1,:) = {'2009-12-31', [45, 49, 0]};
temperature(2,:) = {'2010-04-03', [54, 68, 21]};
temperature(3,:) = {'2010-06-20', [72, 85, 53]};
temperature(4,:) = {'2010-09-15', [63, 81, 56]};
temperature(5,:) = {'2010-12-09', [38, 54, 18]};
temperature
```

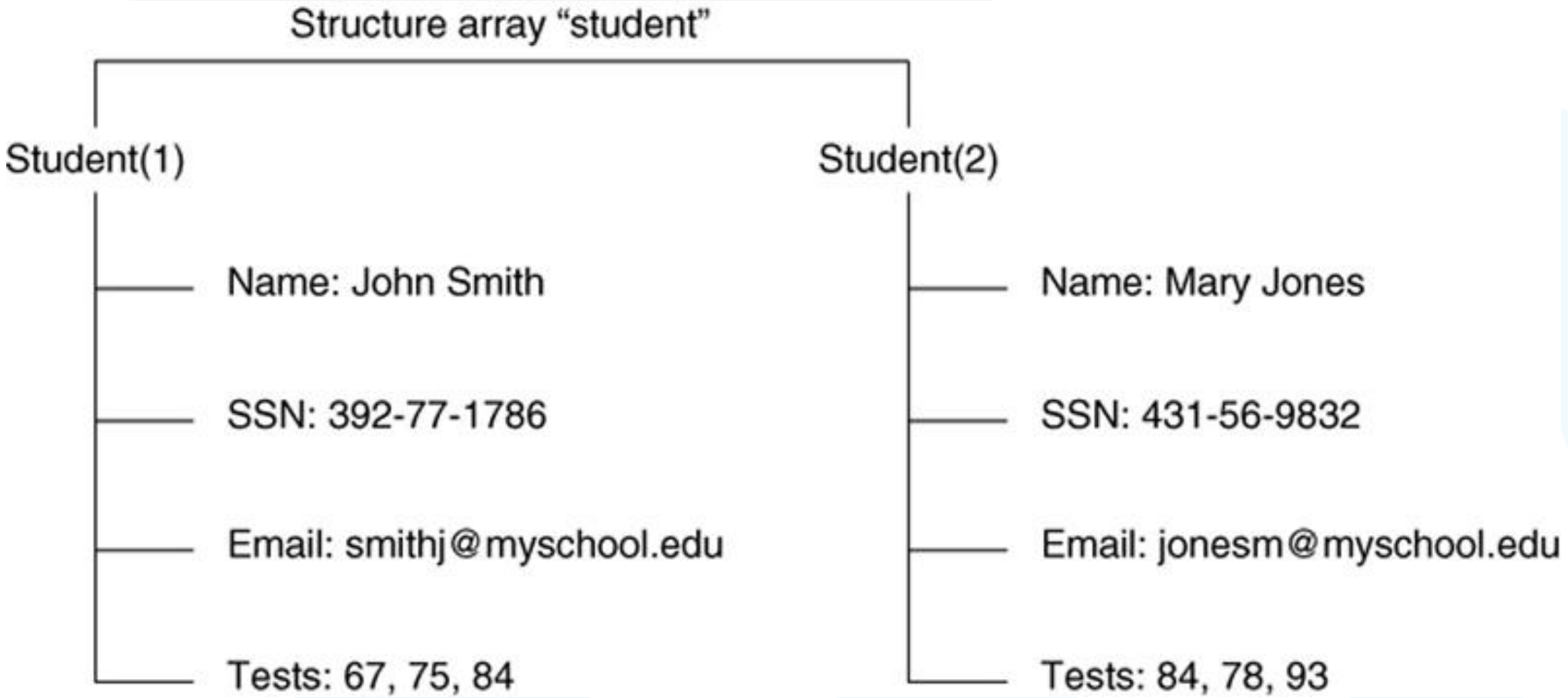
```
>> lec8_5

temperature =

  5×2 cell array

    {'2009-12-31'}    {1×3 double}
    {'2010-04-03'}    {1×3 double}
    {'2010-06-20'}    {1×3 double}
    {'2010-09-15'}    {1×3 double}
    {'2010-12-09'}    {1×3 double}
```

temperature

5x2 cell

	1	2
1	'2009-12-31'	[45,49,0]
2	'2010-04-03'	[54,68,21]
3	'2010-06-20'	[72,85,53]
4	'2010-09-15'	[63,81,56]
5	'2010-12-09'	[38,54,18]

Arrangement of data in the structure array student.



Structure Arrays

```
student(1).name = 'John Doe';
student(1).SSN = '392-77-1786';
student(1).email ='john@yahoo.com';
student(1).test = [79, 75, 73; 180, 178, 177.5; 220, 210, 205];

student(2).name = 'Ann Lane';
student(2).SSN = '431-56-9832';
student(2).email = 'ann@yahoo.com';
student(2).test = [68, 70, 68; 118, 118, 119; 172, 170, 169];
student
```

```
>> lec8_6

student =

  1×2 struct array with fields:

    name
    SSN
    email
    test
```

student

1x2 struct with 4 fields

Fields	name	SSN	email	test
1	'John Doe'	'392-77-1786'	'john@yahoo.com'	[79,75,73;180,178,177.5000;220,210,205]
2	'Ann Lane'	'431-56-9832'	'ann@yahoo.com'	[68,70,68;118,118,119;172,170,169]

Structure functions

Function	Description
names = fieldnames(S)	Returns the field names associated with the structure array S as names, a cell array of strings.
F = getfield(S,'field')	Returns the contents of the field 'field' in the structure array S. Equivalent to F = S.field.
isfield(S,'field')	Returns 1 if 'field' is the name of a field in the structure array S, and 0 otherwise.

Structure functions

`S = rmfield(S,'field')`	Removes the field 'field' from the structure array S.
`S = setfield(S,'field',V)`	Sets the contents of the field 'field' to the value V in the structure array S.
`S = struct('f1','v1','f2','v2',...)`	Creates a structure array with the fields 'f1', 'f2', . . . having the values 'v1', 'v2', ...

Structure functions

```
names = fieldnames(student)
```

names =

4×1 cell array

{'name' }
{'SSN' }
{'email'}
{'test' }

```
F2 = getfield(student(2),'test')
```

F2 =

68	70	68
118	118	119
172	170	169

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Thanks .