L18. Cell Arrays

Set-Up
Subscripting
Nested Loops
String Manipulations

A Small Cell Array…

```
C = { 'Alabama','New York','Utah'};
```

C:

'Alabama'	'New York'	'Utah'

Syntax

Entries Separated by Commas

```
C = { 'Alabama','New York','Utah'};
```

Curly Brackets

Synonym

```
C = { 'Alabama','New York','Utah'};
```

```
C = cell(1,3);
C{1} = 'Alabama';
C{2} = 'New York';
C{3} = 'Utah';
```

Application: Storing strings

"Vertical" Cell Array Set-up

```
C = { 'Alabama';'New York';'Utah'};
```

```
C = cell(3,1);
C{1} = 'Alabama';
C{2} = 'New York';
C{3} = 'Utah';
```

Application: Storing strings

Another Small Cell Array…

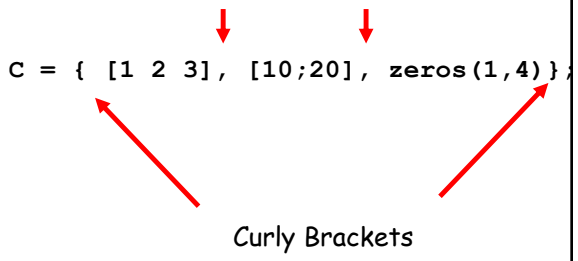
```
C = { [1 2 3],[10;20], zeros(1,4)};
```

C:

[1 2 3]	[10;20]	zeros(1,4)

Syntax

Entries Separated by Commas



```
C = { [1 2 3], [10;20], zeros(1,4)};
```

Curly Brackets

Synonym

```
C = { [1 2 3], [10;20], zeros(1,4)};
```

```
C = cell(1,3);
C{1} = [1 2 3];
C{2} = [10;20];
C{3} = zeros(1,4);
```

Application: Storing a Set of Arrays

Problem: Set Up a Card Deck

Idea…

```
A{1} = 'A Hearts';
A{2} = '2 Hearts';
        :
A{13} = 'K Hearts';
A{14} = 'A Clubs';
        :
A{52} = 'K Diamonds';
```

Initializations…

```
suit = {'Hearts', 'Clubs', …
        'Spades', 'Diamonds'};

rank = {'A','2','3','4','5','6',…
    '7','8','9','10','J','Q','K'};

A = cell(1,52);
```

Use Concatenation…

```
suit = {'Hearts', 'Clubs', …
        'Spades', 'Diamonds'};

rank = {'A','2','3','4','5','6',…
    '7','8','9','10','J','Q','K'};

A{16} = [rank{3} ' ' suit{2} ]
```

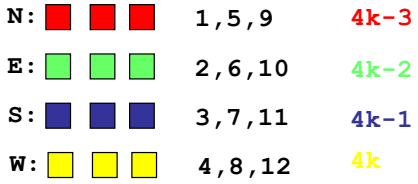
A{16} = '3 Clubs'

Nested Loop to Get all Possible Combinations…

```
% i is index of next card…
  i = 1;
  for k=1:4
% Set up the cards in suit k
     for j=1:13
        A{i} = [ rank{j} ' ' suit{k} ];
        i = i+1
     end
  end
```

Problem: Deal a Card Deck

Deal a length-12 Card Deck



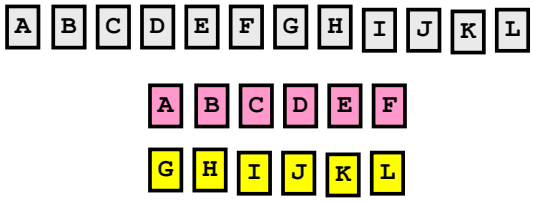

```
N = cell(1,13); E = cell(1,13);
S = cell(1,13); W = cell(1,13);

 for k=1:13
    N{k} = A{4*k-3};
    E{k} = A{4*k-2};
    S{k} = A{4*k-1};
    W{k} = A{4*k};
 end
```

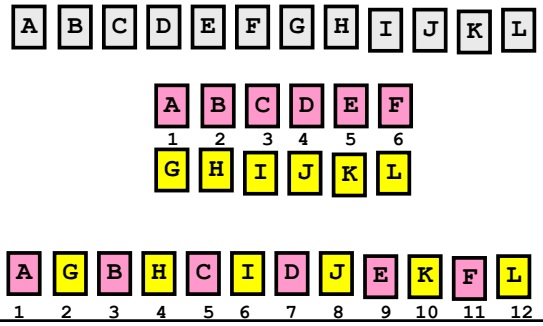
Problem: Shuffle a Card Deck

Shuffle a length-12 Card Deck

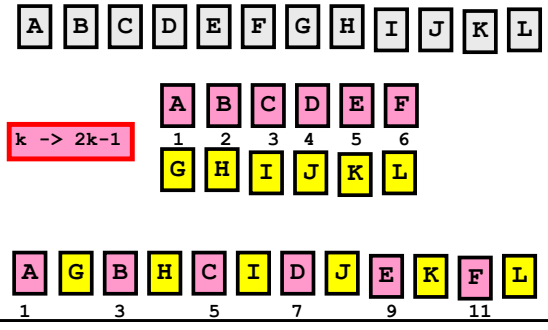
Step 1: Cut the Deck



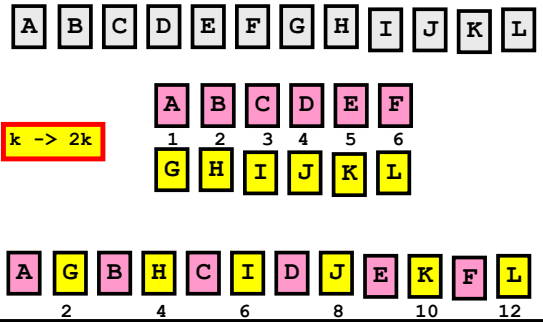
Step 2: Alternate



Step 2: Alternate



Step 2: Alternate




```
function T = Shuffle(S)
n = length(S); m = n/2;
T = cell(n,1);
Top = S(1:m);
Bot = S(m+1:n);
for k=1:m
   T{2*k-1} = Top{k};
   T{2*k}   = Bot{k};
end
```

8 Shuffles with a Card Deck…

And you are back where you started.

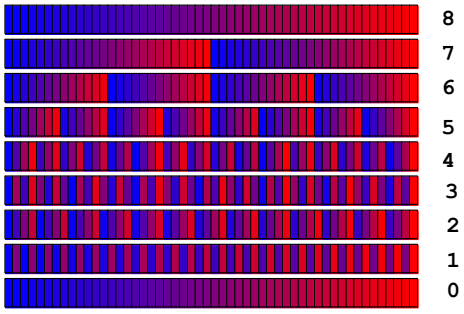
Illustrate with Color

```
% Set up a 52-color spectrum

C = cell(52,1);
for k=1:52
    f = (k-1)/51;
    C{k} = [f 0 1-f];
end
```


These are colors

Using fill(, , C{k})…



Problem: Build Cell Array of Roman Numerals

Idea…

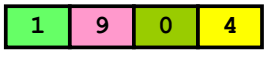
```
C{1} = 'I'
C{2} = 'II'
C{3} = 'III'
   :
C{2007} = 'MMVII'
   :
C{3999} = 'MMMXMXCIX'
```

A Conversion Problem

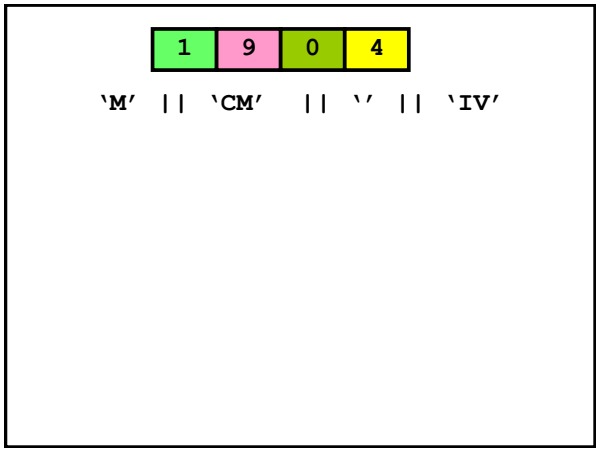
1904 = 1*1000 + 9*100 + 0*10 + 4*1

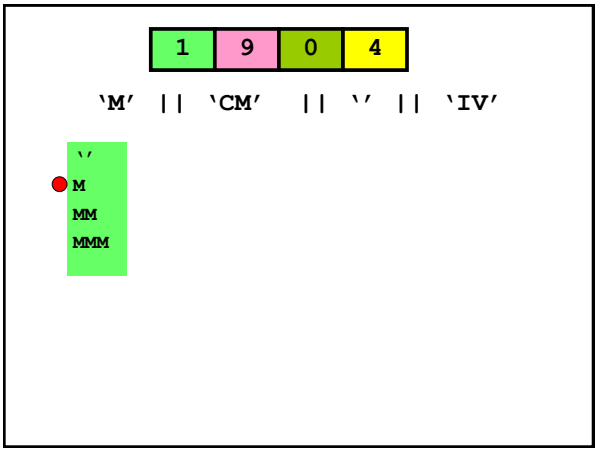
= M CM IV

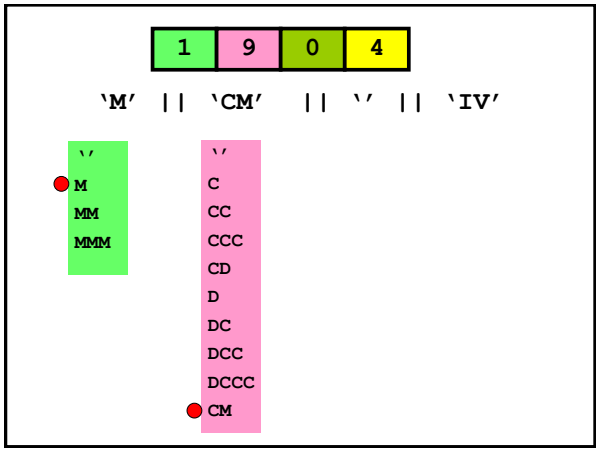
= MCMIV

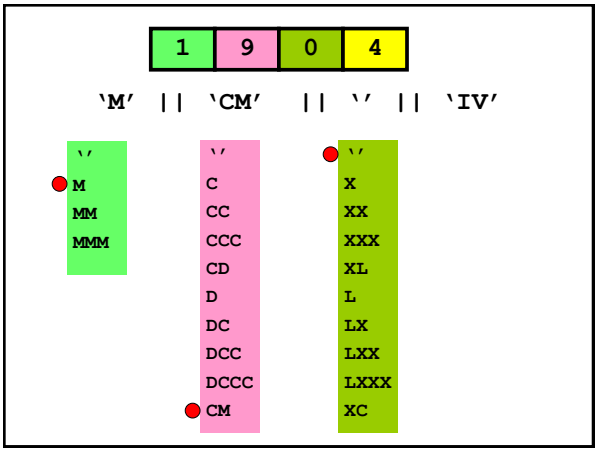


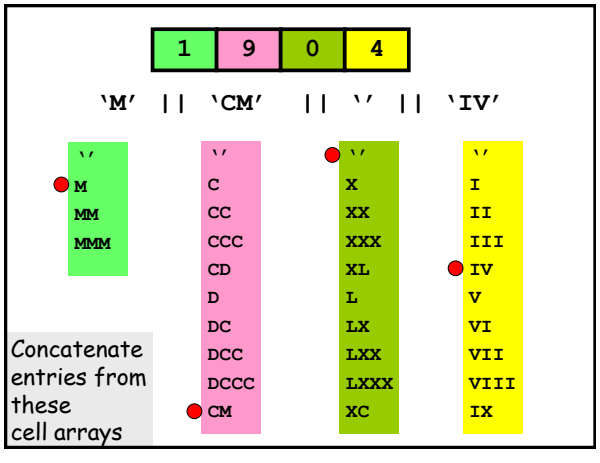
MCMIV











Ones-Place Conversion

```
  function r = Ones2R(x)
% x is an integer that satisfies
%       0 <= x <= 9
% r is the Roman numeral with value x.

Ones = {'I', 'II', 'III', 'IV',…
      'V', 'VI','VII', 'VIII', 'IX'};

if x==0
      r = '';
else
      r = Ones{x};
end
```

Tens-Place Conversion

```
  function r = Tens2R(x)
% x is an integer that satisfies
%       0 <= x <= 9
% r is the Roman numeral with value 10x.

Tens = {'X', 'XX', 'XXX', 'XL',…
      'L', 'LX','LXX', 'LXXX', 'XC'};

if x==0
      r = '';
else
      r = Tens{x};
end
```

Hundreds-Place Conversion

```
  function r = Hund2R(x)
% d is an integer that satisfies
%       0 <= x <= 9
% r is the Roman numeral with value 100x.

Hund = {'C', 'CC', 'CCC', 'CD',…
      'D', 'DC','DCC', 'DCCC', 'CM'};

if x==0
      r = '';
else
      r = Hund{x};
end
```

Thousands-Place Conversion

```
  function r = Thou2R(x)
% d is an integer that satisfies
%       0 <= x <=3
% r is the Roman numeral with value 1000x.

Thou = {'M', 'MM', 'MMM'};

if x==0
      r = '';
else
      r = Thou{x};
end
```

Back to Our Problem

```
C{1} = 'I'
C{2} = 'II'
C{3} = 'III'
   :
C{2007} = 'MMVII'
   :
C{3999} = 'MMMXMXCIX'
```

Generate 1,…,3999

a	b	c	d

0 <= a <= 3

0 <= b <= 9

0 <= c <= 9

0 <= d <= 9

This Prints 0,…,3999

```
for a = 0:3
  for b = 0:9
    for c = 0:9
      for d = 0:9

        n = a*1000 + b*100 + c*10 + d

      end
    end
  end
end
```

```
n = a*1000 + b*100 + c*10 + d;
if n > 0

    C{n} = [Thou(a) Hund(b)…
              Tens(c) Ones(d)];

end
```

Reverse Problem

Given Roman Numeral, compute its value.

Assume cell array C(3999,1) available:

```
C{1} = 'I'
   :
C{3999} = 'MMMCMXCIX'
```

```
  function k = RN2Int(r)
% r is a string that represents
%      Roman numeral
% k is its value

  C = RomanNum();
  k=1;
  while ~strcmp(r,C{k})
     k=k+1;
  end
```