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Explores some basic concepts of cell arrays.

```
a = ['David', 'John', 'Stephen']  % list array[]
b = ['David  '; 'John   '; 'Stephen']
size(b)
c = char('David', 'John', 'Stephen') % char array()
size(c)
d = {'David', 'John', 'Stephen'}  % cell array{}
d(1)
d{1}
d{1}(1)
d{3}(7)
```

```
a =

    'DavidJohnStephen'


b =

  3×7 char array

    'David  '
    'John   '
    'Stephen'


ans =

     3     7


c =
```

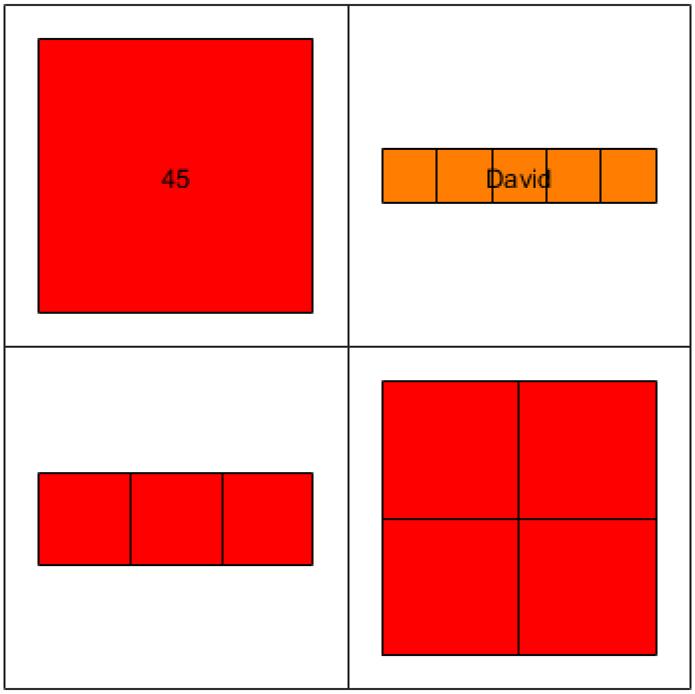
```
  3×7 char array

    'David  '
    'John   '
    'Stephen'


ans =

     3     7


d =

  1×3 cell array

    {'David'}    {'John'}    {'Stephen'}


ans =

  1×1 cell array

    {'David'}


ans =

    'David'


ans =

    'D'


ans =

    'n'
```

Explores some basic concepts of cell arrays.

```
a = 45;
b = 'David';
c = [1, 2, 3];
d = [4, 5; 6, 7];
e = {a, b; c, d}
disp(e)
celldisp(e) % disp ###cell
cellplot(e) % Graphically display structure of cell array
e{1,1}
```

```
e{2,1}(2)
e{1,2}(1)
e{2,2}(2,1)


e =

  2×2 cell array

    {[       45]}    {'David'   }
    {1×3 double}    {2×2 double}

    [         45]    'David'
    [1×3 double]    [2×2 double]


e{1,1} =

    45



e{2,1} =

     1     2     3



e{1,2} =

David


e{2,2} =

     4     5
     6     7



ans =

    45


ans =

     2


ans =

    'D'
```

```
ans =

     6
```



Demonstrates a variable-length inputargument function

```
p = area('circle', 5)
q = area('square', 6)
s = area('rectangle', 7, 8)
t = area('triangle', 'bh', 9, 10)
u = area('triangle', 'abc', 5, 6, 7)
```

Demonstrates a variablelength input-and-out-outargument function.

```
Ac = properties('circle', 5)
As = properties('square', 6)
Ar = properties('rectangle', 7, 8)
[Ac, Ic] = properties('circle', 5)
[As, Is] = properties('square', 6)
```

```
[Ar, Ir] = properties('rectangle', 7, 8)
```

```
Ac =

   78.5398


As =

    36


Ar =

    56


Ac =

   78.5398


Ic =

  490.8739


As =

    36


Is =

   108


Ar =

    56


Ir =

  298.6667
```

Demonstrates some basic concepts of structures.

```
node.x = 1;
```

```
node.y = 1;
node.supportx = 0;
node.supporty = 0;
node.loadx = 0;
node.loady = -1000;
disp(node)
clear
node =
 struct('x',1,'y',1,'supportx',0,'supporty',0,'loadx',0,'loady',-1000) %
 ####=> ## Python dict
Nodes(1) = node
Nodes(2) =
 struct('x',0,'y',0,'supportx',1,'supporty',1,'loadx',0,'loady',0);
Nodes(3) =
 struct('x',2,'y',0,'supportx',0,'supporty',1,'loadx',0,'loady',0);
disp(Nodes)
Nodes(1).x = 5.6;
disp(Nodes(1))
disp(node)
fieldnames(Nodes)
```

```
           x: 1
           y: 1
    supportx: 0
    supporty: 0
       loadx: 0
       loady: -1000


node =

  struct with fields:

           x: 1
           y: 1
    supportx: 0
    supporty: 0
       loadx: 0
       loady: -1000


Nodes =

  struct with fields:

           x: 1
           y: 1
    supportx: 0
    supporty: 0
       loadx: 0
       loady: -1000

  1×3 struct array with fields:
```

```
    x
    y
    supportx
    supporty
    loadx
    loady

           x: 5.6000
           y: 1
    supportx: 0
    supporty: 0
       loadx: 0
       loady: -1000

           x: 1
           y: 1
    supportx: 0
    supporty: 0
       loadx: 0
       loady: -1000


ans =

  6×1 cell array

    {'x'       }
    {'y'       }
    {'supportx'}
    {'supporty'}
    {'loadx'   }
    {'loady'   }
```

Modifies Example03_15, using structures to represent nodal/member data.

```
Nodes = struct; Members = struct;
disp(' 1. Input nodal coordinates')
disp(' 2. Input connecting nodes of members')
disp(' 3. Input three supports')
disp(' 4. Input loads')
disp(' 5. Print truss')
disp(' 6. Solve truss')
disp(' 7. Print results')
disp(' 8. Save data')
disp(' 9. Load data')
disp('10. Quit')
while 1
    task = input('Enter the task number: ');
    switch task
        case 1
```

```
            Nodes = inputNodes(Nodes);
        case 2
            Members = inputMembers(Members);
        case 3
            Nodes = inputSupports(Nodes);
        case 4
            Nodes = inputLoads(Nodes);
        case 5
            printTruss(Nodes, Members)
        case 6
            [Nodes, Members] = solveTruss(Nodes, Members);
        case 7
            printResults(Nodes, Members)
        case 8
            saveAll(Nodes, Members)
        case 9
            [Nodes, Members] = loadAll;
        case 10
            break
    end
end
```

```
 1. Input nodal coordinates
 2. Input connecting nodes of members
 3. Input three supports
 4. Input loads
 5. Print truss
 6. Solve truss
 7. Print results
 8. Save data
 9. Load data
10. Quit

Error using input
Cannot call INPUT from EVALC.

Error in Example1 (line 69)
    task = input('Enter the task number: ');
```

Demonstrates some basic concepts of tables.

```
x = [1, 0, 2]'; y = [1, 0, 0]';
supportx = [0, 1, 0]'; supporty = [0, 1, 1]';
loadx = [0, 0, 0]'; loady = [-1000, 0, 0]';
Nodes = table(x, y, supportx, supporty, loadx, loady) % Table array
 with named variables that can contain different types
Nodes.Properties;
Nodes.Properties.RowNames = {'top', 'left', 'right'};
% disp(Nodes);
size(Nodes); % 3 X 6#table
Nodes = sortrows(Nodes, {'x', 'y'}); % sortrows: ##########{x,y}##
node = Nodes(2,:);
Nodes(4,:) = array2table([2, 2, 0, 0, 100, 200]); % array2table #array
##table##Node#4#
```

```
Nodes.Properties.RowNames{4} = 'node4'; % #4####node4
Nodes(5,:) = cell2table({0, 2, 0, 0, 0, 0});
n = struct('x', 1.5, 'y', 0.5, ...
    'supportx', 0, 'supporty', 0, 'loadx', 0, 'loady',0)
Nodes = [Nodes; struct2table(n)];
Nodes(6,5) = array2table(300)
class(Nodes(6,5)) % class : #########
Nodes.loady(6) = 150;
class(Nodes.loadx(6))
disp(Nodes)
Nodes(4:6,:) = [];
disp(Nodes)
Nodes(1:3,:) = [];
size(Nodes)
```

Creates a cell array to store the polymer data and converts the cell array to a structure array and to a table

```
Polymer_Cell = {'Polyethylene',                'PE',  135,  56, 0.96;
                'Polypropylene',               'PP',  171,  86, 0.95;
                'Polyoxymethylene',            'POM', 180,  90, 1.42;
                'Polyethylene terephthalate', 'PET', 266, 158, 1.38};
PET_Name = Polymer_Cell{4,1}; % accessing from cell index
PET_Melting = Polymer_Cell{4,3};

Field =
 {'Name', 'Abbreviation', 'Melting', 'Crystallization', 'Density'};
Polymer_Structure = cell2struct(Polymer_Cell, Field, 2);  %
 cell2struct(a, fields, dim)
PET_Name = Polymer_Structure(4).Name;
PET_Melting = Polymer_Structure(4).Melting;

Polymer_Table = cell2table(Polymer_Cell, 'VariableNames', Field)
PET_Name = Polymer_Table.Name(4)
PET_Melting = Polymer_Table.Melting(4)
PET_Name = Polymer_Table(4,1)
PET_Melting = Polymer_Table(4,3)
```

Creates a structure array to store the polymer data and converts the structure array to a cell array and to a table.

```
Polymer_Structure = [struct('Name', 'Polyethylene',                ...
                            'Abbreviation', 'PE',                  ...
                            'Melting', 135,                        ...
                            'Crystallization', 56,                 ...
                            'Density', 0.96);
```

```
                     struct('Name', 'Polypropylene',                ...
                            'Abbreviation', 'PP',                    ...
                            'Melting', 171,                          ...
                            'Crystallization', 86,                   ...
                            'Density', 0.95);
                     struct('Name', 'Polyoxymethylene',             ...
                            'Abbreviation', 'POM',                   ...
                            'Melting', 180,                          ...
                            'Crystallization', 90,                   ...
                            'Density', 1.42);
                     struct('Name', 'Polyethylene terephthalate',   ...
                            'Abbreviation', 'PET',                   ...
                            'Melting', 266,                          ...
                            'Crystallization', 158',                 ...
                            'Density', 1.38)];
PET_Name = Polymer_Structure(4).Name
PET_Melting = Polymer_Structure(4).Melting

Polymer_Cell = struct2cell(Polymer_Structure);
Polymer_Cell = Polymer_Cell';
PET_Name = Polymer_Cell{4,1}
PET_Melting = Polymer_Cell{4,3}

Polymer_Table = struct2table(Polymer_Structure);
PET_Name = Polymer_Table.Name(4)
PET_Melting = Polymer_Table.Melting(4)
PET_Name = Polymer_Table(4,1)
PET_Melting = Polymer_Table(4,3)
```

Creates a table to store the polymer data and converts the table to a cell array and to a structure array.

```
Name = {'Polyethylene', 'Polypropylene', 'Polyoxymethylene', ...
        'Polyethylene terephthalate'}';
Abbreviation = {'PE', 'PP', 'POM', 'PET'}';
Melting = [135, 171, 180, 266]';
Crystallization = [56, 86, 90, 1585]';
Density = [0.96, 0.95, 1.42, 1.38]';
Polymer_Table =
 table(Name,Abbreviation,Melting,Crystallization,Density);
PET_Name = Polymer_Table.Name(4)
PET_Melting = Polymer_Table.Melting(4)
PET_Name = Polymer_Table(4,1)
PET_Melting = Polymer_Table(4,3)

Polymer_Cell = table2cell(Polymer_Table);
PET_Name = Polymer_Cell{4,1}
PET_Melting = Polymer_Cell{4,3}

Polymer_Structure = table2struct(Polymer_Table);
```

```
PET_Name = Polymer_Structure(4).Name
PET_Melting = Polymer_Structure(4).Melting
```

Demonstrates the use of a user-defined class poly.

```
a = Poly(3,2,1) % #######.
b = Poly(5,6)
c = Poly(8)
d = a+b
e = -a-b*(-c+a)
value(e, 2.5)
x = linspace(-3,3);
y = value(e,x);
plot(x,y)
```

function

```
function output = area(varargin)
output = 0;
switch varargin{1}
    case 'circle'
        if nargin == 2          % nargin : #######
            r = varargin{2};
            output = pi*r^2;
        end
    case 'square'
        if nargin == 2
            a = varargin{2};
            output = a^2;
        end
    case 'rectangle'
        if nargin == 3
            b = varargin{2};
            h = varargin{3};
            output = b*h;
        end
    case 'triangle'
        if strcmp(varargin{2},'bh') && nargin == 4
            b = varargin{3};
            h = varargin{4};
            output = b*h/2;
        elseif strcmp(varargin{2}, 'abc') && nargin == 5
            a = varargin{3};
            b = varargin{4};
            c = varargin{5};
            R = a*b*c/sqrt((a+b+c)*(a-b+c)*(b-c+a)*(c-a+b));
            output = a*b*c/(4*R);
        end
end
end
```

```
% --------------------------------------------------------------------
function varargout = properties(varargin)
varargout{1} = 0;
switch varargin{1}
    case 'circle'
        if nargin == 2
            r = varargin{2};
            varargout{1} = pi*r^2;
            if nargout == 2
                varargout{2} = pi*r^4/4;
            end
        end
    case 'square'
        if nargin == 2
            a = varargin{2};
            varargout{1} = a^2;
            if nargout == 2
                varargout{2} = a^4/12;
            end
        end
    case 'rectangle'
        if nargin == 3
            b = varargin{2};
            h = varargin{3};
            varargout{1} = b*h;
            if nargout == 2
                varargout{2} = b*h^3/12;
            end
        end
end
end
% --------------------------------------------------------------------
function output = inputNodes(Nodes)
while 1
    data = input('Enter [node, x, y] or 0 to stop: ');
    if data(1) == 0
        break
    else
        Nodes(data(1)).x = data(2);
        Nodes(data(1)).y = data(3);
    end
end
output = Nodes;
end

function output = inputMembers(Members)
m = 0;
while 1
    data = input('Enter [node1, node2] or 0 to stop: ');
    if data(1) == 0
        break
    else
        m = m+1;
        Members(m).node1 = data(1);
```

```
        Members(m).node2 = data(2);
    end
end
output = Members;
end

function output = inputSupports(Nodes)
for i = 1:size(Nodes,2)
    Nodes(i).supportx = 0;
    Nodes(i).supporty = 0;
end
for k = 1:3
    data = input('Enter [node, dir] (dir: ''x'' or ''y''): ');
    if data(2) == 'x'
        Nodes(data(1)).supportx = 1;
    elseif data(2) == 'y'
        Nodes(data(1)).supporty = 1;
    end
end
output = Nodes;
end

function output = inputLoads(Nodes)
for i = 1:size(Nodes,2)
    Nodes(i).loadx = 0;
    Nodes(i).loady = 0;
end
while 1
    data = input('Enter [node, load-x, load-y] or 0 to stop: ');
    if data(1) == 0
        break
    else
        Nodes(data(1)).loadx = data(2);
        Nodes(data(1)).loady = data(3);
    end
end
output = Nodes;
end

function printTruss(Nodes, Members)
if (size(fieldnames(Nodes),1)<6 || size(fieldnames(Members),1)<2)
    disp('Truss data not complete'); return
end
fprintf('\nNodal Data\n')
fprintf('Node        x        y  Support-x  Support-y   Load-x   Load-
y\n')
for k = 1:size(Nodes,2)
    fprintf('%4.0f%9.2f%9.2f%11.0f%11.0f%9.0f%9.0f\n', ...
        k, Nodes(k).x, Nodes(k).y, ...
        Nodes(k).supportx, Nodes(k).supporty, ...
        Nodes(k).loadx, Nodes(k).loady)
end
fprintf('\nMember Data\n')
fprintf('Member  Node1    Node2\n')
```

```
for k = 1:size(Members,2)
    fprintf('%4.0f%9.0f%9.0f\n', k, Members(k).node1,
 Members(k).node2)
end
end

function printResults(Nodes, Members)
if (size(fieldnames(Nodes),1)<8 || size(fieldnames(Members),1)<3)
    disp('Results not available!'), return
end
fprintf('\nReaction Forces\n')
fprintf('Node  Reaction-x  Reaction-y\n')
for k = 1:size(Nodes,2)
    fprintf('%4.0f%12.2f%12.2f\n', k, Nodes(k).reactionx,
 Nodes(k).reactiony)
end
fprintf('\nMember Forces\n')
fprintf('Member     Force\n')
for k = 1:size(Members,2)
    fprintf('%4.0f%12.2f\n', k, Members(k).force)
end
end

function saveAll(Nodes, Members)
fileName = input('Enter file name (default Datafile): ', 's');
if isempty(fileName)
    fileName = 'Datafile';
end
save(fileName, 'Nodes', 'Members')
end

function [Nodes, Members] = loadAll
fileName = input('Enter file name (default Datafile): ', 's');
if isempty(fileName)
    fileName = 'Datafile';
end
load(fileName)
end

function [outNodes, outMembers] = solveTruss(Nodes, Members)
n = size(Nodes,2); m = size(Members,2);
if (m+3) < 2*n
    disp('Unstable!')
    outNodes = 0; outMembers = 0; return
elseif (m+3) > 2*n
    disp('Statically indeterminate!')
    outNodes = 0; outMembers = 0; return
end
A = zeros(2*n, 2*n); loads = zeros(2*n,1); nsupport = 0;
for i = 1:n
    for j = 1:m
        if Members(j).node1 == i || Members(j).node2 == i
            if Members(j).node1 == i
                n1 = i; n2 = Members(j).node2;
```

```
            elseif Members(j).node2 == i
                n1 = i; n2 = Members(j).node1;
            end
            x1 = Nodes(n1).x; y1 = Nodes(n1).y;
            x2 = Nodes(n2).x; y2 = Nodes(n2).y;
            L = sqrt((x2-x1)^2+(y2-y1)^2);
            A(2*i-1,j) = (x2-x1)/L;
            A(2*i,  j) = (y2-y1)/L;
        end
    end
    if (Nodes(i).supportx == 1)
        nsupport = nsupport+1;
        A(2*i-1,m+nsupport) = 1;
    end
    if (Nodes(i).supporty == 1)
        nsupport = nsupport+1;
        A(2*i, m+nsupport) = 1;
    end
    loads(2*i-1) = -Nodes(i).loadx;
    loads(2*i)   = -Nodes(i).loady;
end
forces = A\loads;
for j = 1:m
    Members(j).force = forces(j);
end
nsupport = 0;
for i = 1:n
    Nodes(i).reactionx = 0;
    Nodes(i).reactiony = 0;
    if (Nodes(i).supportx == 1)
        nsupport = nsupport+1;
        Nodes(i).reactionx = forces(m+nsupport);
    end
    if (Nodes(i).supporty == 1)
        nsupport = nsupport+1;
        Nodes(i).reactiony = forces(m+nsupport);
    end
end
outNodes = Nodes; outMembers = Members;
disp('Solved successfully.')
end

% -----------------------------------------------------------------
```

```
p =

   78.5398


q =

    36
```

```
s =

    56

t =

    45

u =

   14.6969
```

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