# Crashcourse in Matlab - Part VII: Odds N Ends

These are just some of the things that will be useful that didn't fit in anywhere else.

## Structures

As codes grow more complex functions often need a large number of inputs and may give a large number of outputs. If you would have to pass all these individually your code would quickly become unreadable. Structures are ways that allow you to collect large amounts of information and then pass them as one piece. For example, we can collect all the information about our grid in a structure as follows.

```
Grid.xmin = 0;
Grid.xmax = 10;
Grid.ymin = 0;
Grid.ymax = 1;
Grid.Nx = 15;
Grid.Ny = 5;
Grid.coord = 'cartesian';

Grid.Nx
```

```
ans = 15
```

Note that you can have different types of fields (numbers, vectors, matrices, and strings) in the same structure.

## Logical indexing

In many cases it is usefult to access parts of arrays based on logical conditions. This could be done with for-loops and if-statements, but matlab has a clean vectorized way of acomplishing this.

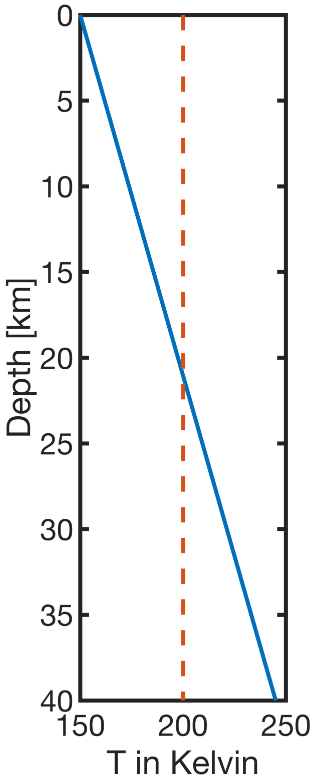
Suppose you have geothermal profile and you want to find all the elements of an array above a certain temperature to determine where the crust is partially molten.

```
clf
H = 40; % crustal thinkness in km
Tsurf = 150; % surface temperature in Kelvin
Tbase = 245; % basal temperature in Kelvin
Tmelt = 200;     % selected temperature in Kelvin
depth = linspace(0,H,1e2);
T = Tsurf + (Tbase-Tsurf)*depth/H;
clf
h = figure
```

```
h =
  Figure (7) with properties:

      Number: 7
        Name: ''
       Color: [0.9400 0.9400 0.9400]
    Position: [360 278 560 420]
```

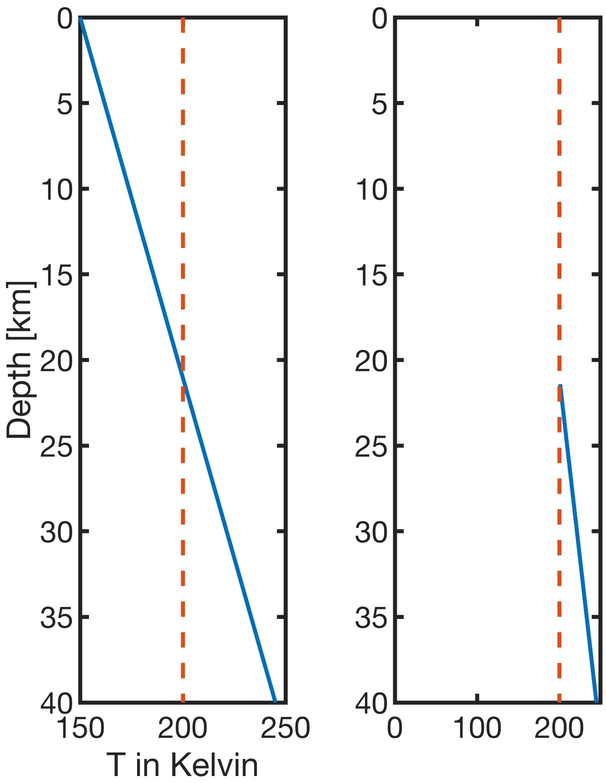
```
        Units: 'pixels'

    Show all properties
```

```
subplot 131
plot(T,depth), hold on
plot(Tmelt*[1 1],[0 H],'--')
set(gca','ydir','reverse')
ylabel('Depth [km]'), xlabel('T in Kelvin')
pbaspect([.3 1 1])
```



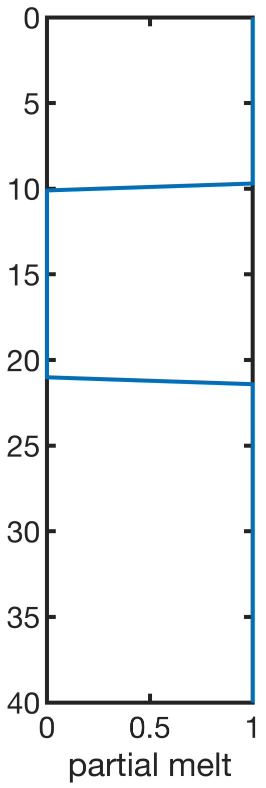
You can select the appropriate part of the T vector as follows

```
Tpartial = T(T>Tmelt);
depth_partial = depth(T>Tmelt);
figure(h)
subplot 132
plot(Tpartial,depth_partial), hold on
plot(Tmelt*[1 1],[0 H],'--')
set(gca','ydir','reverse')
xlim([0 250])
pbaspect([.3 1 1])
```



You can also generate an index vector, i.e., zeros and ones, that tells you where partial melt is

```
clf
ind_partial = T>Tmelt | depth <10;
figure(h)
subplot 133
plot(ind_partial,depth), hold on
set(gca','ydir','reverse')
xlabel('partial melt')
pbaspect([.3 1 1])
```



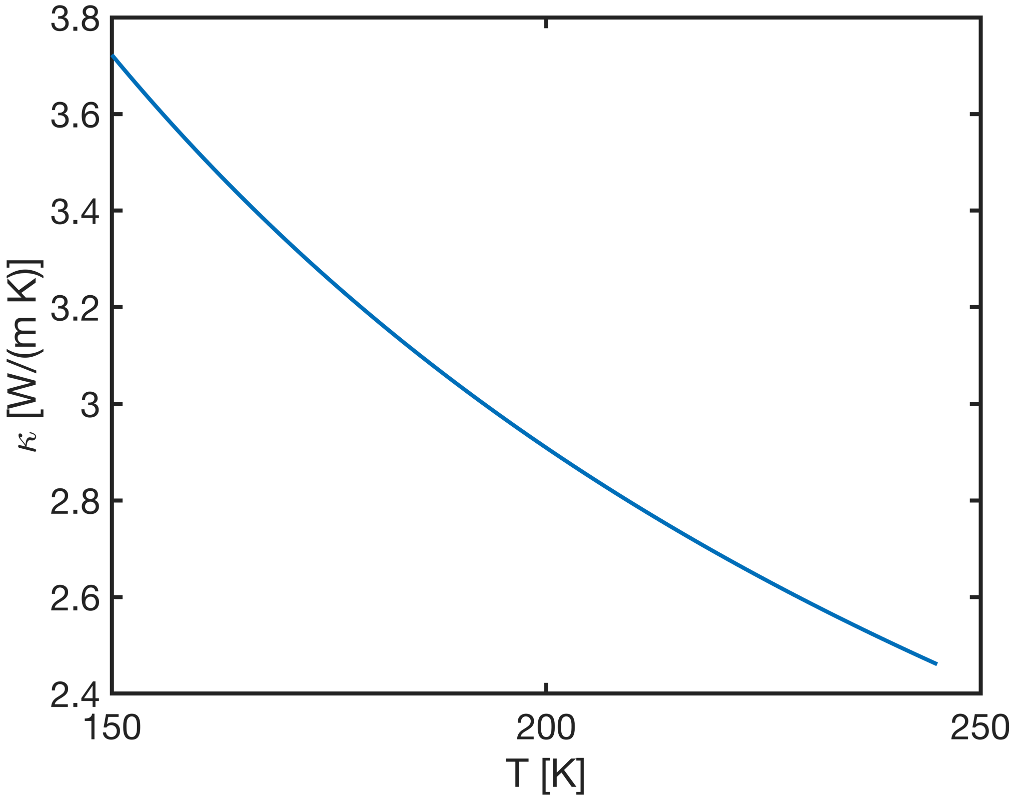
### Anonymous functions

An anonymous function is one that is not stored in a program file. The most obvious reason this might be useful is that is allows you to define small functions on the fly, without having to write and separate function file.

For example, the thermal conductivity of ice is the following function of temperature $\kappa(T) = 0.4685 + \frac{488.12}{T}$.

Our code will use this many times, so to avoid copy-and-paste errors and to ensure consistency, this should be defined as a reusable user defined function.

```
T = linspace(Tsurf,Tbase,1e2);
% kappa = kappa_ice(T); % use proper function
figure
plot(T,kappa_ice(T)), hold on
xlabel('T [K]'), ylabel('\kappa [W/(m K)]')
```



Alternatively we could simply defince the following anonymous function

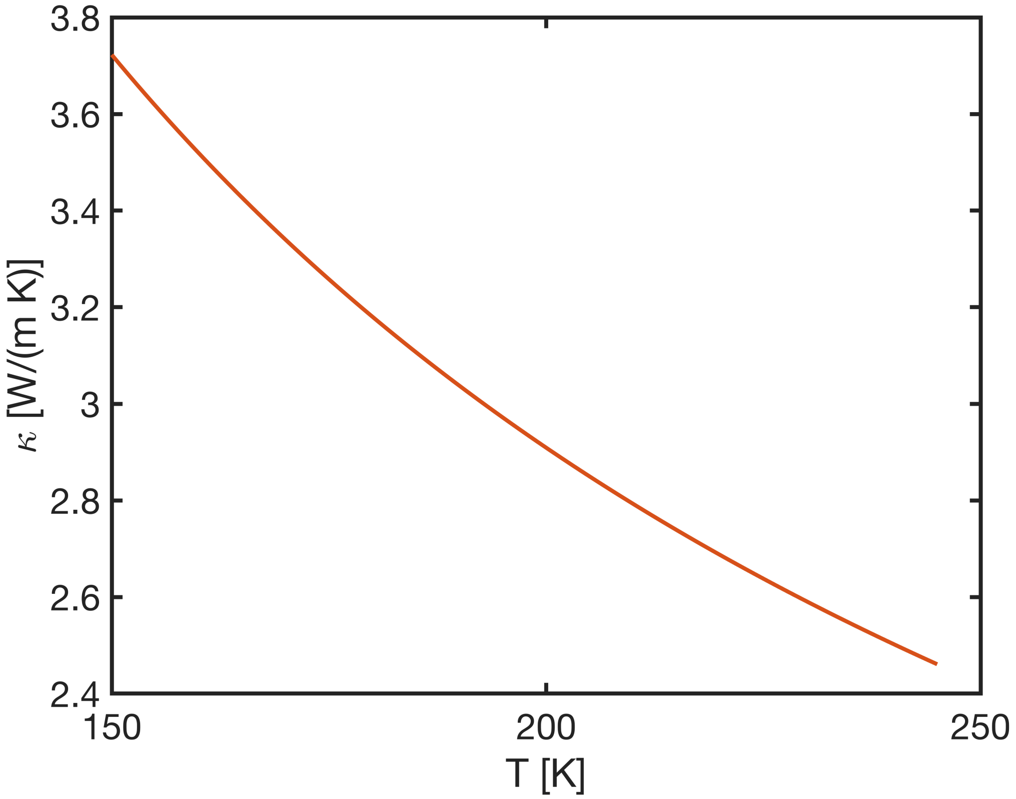
```
T
```

```
T = 1×100
  150.0000   150.9596   151.9192   152.8788   153.8384   154.7980   155.7576   156.7172 ⋯
```

```
kappa_ice2 = @(T) 0.4685 + 488.12./T
```

```
kappa_ice2 = function_handle with value:
    @(T)0.4685+488.12./T
```

```
plot(T,kappa_ice2(T),'-')
xlabel('T [K]'), ylabel('\kappa [W/(m K)]')
```



Anaonymous function can be as complicated as you like. They can have multiple variables. You can have anonymous function of anonymous functions.

### Auxillary functions

```
function [kappa] = kappa_ice(T)
    % author: Marc Hesse
    % date: 30 Jan 2018
    % Description: Evaluates temperature dependent conductivity of ice,
    % based on Castillo-Rogex et al (2007), Icarus, 190(1), 179-202
    % Input: T = array containing temperatures in Kelvin
    % Output: kappa = thermal conductivity of ice in W/(m K)
    kappa = 0.4685 + 488.12./T;
end
```