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HW 7B: Problem 2

Part A: Calculate Temperature of Inner Elements of Plate

```
Ta = 192;
Tb = 51;
tempA = prob7B_2(Ta,Tb)
```

Part B: Fine-Grained Temperature Distribution

Part i

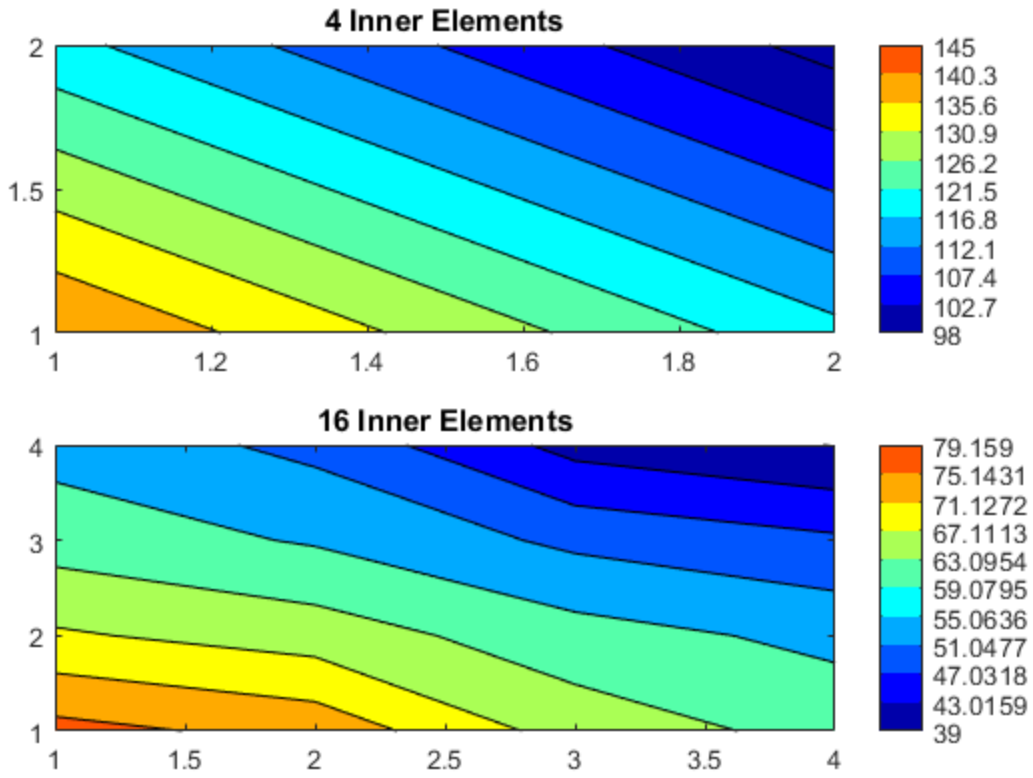
```
tempB = prob7B_2b(Ta,Tb)
```

```
sqA =

     4


B =

   96.0000
         0
         0
         0
   96.0000
         0
         0
         0
         0
         0
         0
```

```
   25.5000
         0
         0
         0
   25.5000


T =

   81.6590   78.2846   67.8603   63.2808
   70.6923   67.6192   62.0154   58.7013
   62.7987   59.4846   53.8808   50.8077
   58.2192   53.6397   43.2154   39.8410


tempB =

   81.6590   78.2846   67.8603   63.2808
   70.6923   67.6192   62.0154   58.7013
   62.7987   59.4846   53.8808   50.8077
   58.2192   53.6397   43.2154   39.8410
```

Part ii

```
subplot(2,1,1)
contourf(tempA);
title('4 Inner Elements')
contourcmap('jet', 'Colorbar', 'on');
subplot(2,1,2)
contourf(tempB);
title('16 Inner Elements')
contourcmap('jet', 'Colorbar', 'on');
```



Contour plot of the 4 inner elements appears to be smoother than the 16 inner elements. This would be a reasonable result as the contour would become more detailed with more features, or inner elements in this case.

Part C

An increase in the number of inner elements would lead to a more detailed temperature profile of the model. However, an increase leads to increased demands on computing storage and power, which after a certain number of points will lead to diminished returns.

Part D

One can automate the process by using a function as executed below that goes through each element and looks around its neighboring elements to fill in another matrix. Disregarding the boundaries makes the problem simpler.

Functions

```
function T = prob7B_2(Tempa,Tempb)

    A =[3 -1 -1 0
        -1 2 0 -1
        -1 0 2 -1
```

```
        0 -1 -1 3
        ]
    B = [Tempa
        0
        0
        Tempb]

    T = A\B;
    T =reshape(T,[2,2])
end
function T = prob7B_2b(Tempa,Tempb)

    A = 1:16;
    sqA = sqrt(length(A))
    A = transpose(reshape(A,[sqA,sqA]));
    for i = 1:numel(A)
        [j k] = find(A == i);
        tmat(i,:) = checkdir(A,j,k,A(j,k));
    end

    B = [Tempa/2;0;0;0;
        Tempa/2;0;0;0
        0;0;0;Tempb/2
        0;0;0;Tempb/2
        ]

    T = tmat\B;
    T =reshape(T,[4,4])
end


 function tmat = checkdir(smallmat,row,col,eqn)
    [m, n] = size(smallmat);
    tmat = zeros(1,numel(smallmat));
    if col == 1 && row == 1 || col == 1 && row == 2
        count = 1;
    elseif col == n && row == m || col== n && row == m-1
        count = 1;
    else
        count = 0;
    end
    if col-1 >= 1
        var = smallmat(row,col-1);
        %Left
        tmat(eqn,var) = -1;
        count = count + 1;
    end
    if col+1 <= n
        var = smallmat(row,col+1);
        %Right
        tmat(eqn,var) = -1;
        count = count + 1;
    end
    if row-1 >= 1
```

```
            var = smallmat(row-1,col);
            %Up
            tmat(eqn,var) = -1;
            count = count + 1;
        end
        if row+1 <= m
            var = smallmat(row+1,col);
            %Down
            tmat(eqn,var) = -1;
            count = count + 1;
        end
        tmat(eqn,eqn) = count;
        tmat = tmat(eqn,:);

    end
```

```
A =

     3    -1    -1     0
    -1     2     0    -1
    -1     0     2    -1
     0    -1    -1     3
```

```
B =

   192
     0
     0
    51
```

```
T =

  145.0000  121.5000
  121.5000   98.0000
```

```
tempA =

  145.0000  121.5000
  121.5000   98.0000
```

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