Matlab Array Broadcast and Expansion Examples

back to Fan's Reusable Matlab Repository or Dynamic Asset Repository.

Matrix broadcasting was added to matlab's recent editions. This is an important step for vectorizing codes. Proper usage of broadcasting reduces memory allocation requirements for matrix matrix operations.

Broadcasting with A Row and a Column

Below we add together a 1 by 3 and 4 by 1 array, that should not work. With broadcasting, it is assumed that we will mesh the arrays and then sum up the meshed matrixes.

```
clear all
ar_A = [1,2,3];
ar_B = [4,3,2,1]';
disp(size(ar_A));
```

```
     1     3
```

```
disp(size(ar_B));
```

```
     4     1
```

```
mt_A_B_broadcast = ar_A + ar_B;
disp(mt_A_B_broadcast);
```

```
     5     6     7
     4     5     6
     3     4     5
     2     3     4
```

```
mt_A_B_broadcast_product = ar_A.*ar_B;
disp(mt_A_B_broadcast_product);
```

```
     4     8    12
     3     6     9
     2     4     6
     1     2     3
```

Broadcasting with One Row and One Matrix

Below we add together a 1 by 3 and 4 by 3 matrix, that should not work. With broadcasting, it is assumed that we will repeat the array four times, duplicating the single row four times, so the matrix dimensions match up.

```
clear all
ar_A = [1,2,3];
mt_B = [4,3,2,1;5,4,3,2;6,5,4,3]';
disp(size(ar_A));
```

```
     1     3
```

```
disp(size(mt_B));
```

```
     4     3
```

```
mt_A_B_broadcast = ar_A + mt_B;
disp(mt_A_B_broadcast);
```

```
     5     7     9
     4     6     8
     3     5     7
     2     4     6
```

```
mt_A_B_broadcast_product = ar_A.*mt_B;
disp(mt_A_B_broadcast_product);
```

```
     4    10    18
     3     8    15
     2     6    12
     1     4     9
```

Broadcasting with One Column and One Matrix

Below we add together a 4 by 1 and 4 by 3 matrix, that should not work. With broadcasting, it is assumed that we will repeat the column three times, duplicating the single column three times, so the matrix dimensions match up.

```
clear all
ar_A = [4,3,2,1]';
mt_B = [4,3,2,1;5,4,3,2;6,5,4,3]';
disp(size(ar_A));
```

```
     4     1
```

```
disp(size(mt_B));
```

```
     4     3
```

```
mt_A_B_broadcast = ar_A + mt_B;
disp(mt_A_B_broadcast);
```

```
     8     9    10
     6     7     8
     4     5     6
     2     3     4
```

```
mt_A_B_broadcast_product = ar_A.*mt_B;
disp(mt_A_B_broadcast_product);
```

```
    16    20    24
     9    12    15
     4     6     8
     1     2     3
```

Expand with Broadcast, Percentage Choice grids

```
clear all
ar_w_perc = [0.1,0.5,0.9]
```

```
ar_w_perc = 1×3
    0.1000    0.5000    0.9000
```

```
ar_w_level = [-2,0,2]
```

```
ar_w_level = 1×3
    -2     0     2
```

```
fl_b_bd = -4
```

```
fl_b_bd = -4
```

```
ar_k_max = ar_w_level - fl_b_bd
```

```
ar_k_max = 1×3
     2     4     6
```

```
ar_ak_perc = [0.1,0.3,0.7,0.9]
```

```
ar_ak_perc = 1×4
    0.1000    0.3000    0.7000    0.9000
```

```
mt_k = (ar_k_max'*ar_ak_perc)'
```

```
mt_k = 4×3
    0.2000    0.4000    0.6000
    0.6000    1.2000    1.8000
    1.4000    2.8000    4.2000
    1.8000    3.6000    5.4000
```

```
mt_a = (ar_w_level - mt_k)
```

```
mt_a = 4×3
   -2.2000   -0.4000    1.4000
   -2.6000   -1.2000    0.2000
   -3.4000   -2.8000   -2.2000
   -3.8000   -3.6000   -3.4000
```

Expand Matrix Twice

```
clear all
% Same as above
ar_w_level = [-2,-1,-0.1]
```

```
ar_w_level = 1×3
   -2.0000   -1.0000   -0.1000
```

```
fl_b_bd = -4
```

```
fl_b_bd = -4
```

```
ar_k_max = ar_w_level - fl_b_bd
```

```
ar_k_max = 1×3
    2.0000    3.0000    3.9000
```

```
ar_ak_perc = [0.001, 0.1,0.3,0.7,0.9, 0.999]
```

```
ar_ak_perc = 1×6
    0.0010    0.1000    0.3000    0.7000    0.9000    0.9990
```

```
mt_k = (ar_k_max'*ar_ak_perc)'
```

```
mt_k = 6×3
    0.0020    0.0030    0.0039
    0.2000    0.3000    0.3900
    0.6000    0.9000    1.1700
    1.4000    2.1000    2.7300
    1.8000    2.7000    3.5100
    1.9980    2.9970    3.8961
```

```
mt_a = (ar_w_level - mt_k)
```

```
mt_a = 6×3
   -2.0020   -1.0030   -0.1039
   -2.2000   -1.3000   -0.4900
   -2.6000   -1.9000   -1.2700
   -3.4000   -3.1000   -2.8300
   -3.8000   -3.7000   -3.6100
   -3.9980   -3.9970   -3.9961
```

```
% fraction of borrowing for bridge loan
ar_coh_bridge_perc = [0, 0.5, 0.999];

% Expand matrix to include coh percentage dimension
mt_k = repmat(mt_k, [1, length(ar_coh_bridge_perc)])
```

```
mt_k = 6×9
    0.0020    0.0030    0.0039    0.0020    0.0030    0.0039    0.0020    0.0030 ···
    0.2000    0.3000    0.3900    0.2000    0.3000    0.3900    0.2000    0.3000
    0.6000    0.9000    1.1700    0.6000    0.9000    1.1700    0.6000    0.9000
    1.4000    2.1000    2.7300    1.4000    2.1000    2.7300    1.4000    2.1000
    1.8000    2.7000    3.5100    1.8000    2.7000    3.5100    1.8000    2.7000
    1.9980    2.9970    3.8961    1.9980    2.9970    3.8961    1.9980    2.9970
```

```
mt_a = repmat(mt_a, [1, length(ar_coh_bridge_perc)])
```

```
mt_a = 6×9
   -2.0020   -1.0030   -0.1039   -2.0020   -1.0030   -0.1039   -2.0020   -1.0030 ···
   -2.2000   -1.3000   -0.4900   -2.2000   -1.3000   -0.4900   -2.2000   -1.3000
   -2.6000   -1.9000   -1.2700   -2.6000   -1.9000   -1.2700   -2.6000   -1.9000
   -3.4000   -3.1000   -2.8300   -3.4000   -3.1000   -2.8300   -3.4000   -3.1000
   -3.8000   -3.7000   -3.6100   -3.8000   -3.7000   -3.6100   -3.8000   -3.7000
   -3.9980   -3.9970   -3.9961   -3.9980   -3.9970   -3.9961   -3.9980   -3.9970
```

```
mt_a = mt_a
```

```
mt_a = 6×9
   -2.0020   -1.0030   -0.1039   -2.0020   -1.0030   -0.1039   -2.0020   -1.0030 ···
   -2.2000   -1.3000   -0.4900   -2.2000   -1.3000   -0.4900   -2.2000   -1.3000
   -2.6000   -1.9000   -1.2700   -2.6000   -1.9000   -1.2700   -2.6000   -1.9000
   -3.4000   -3.1000   -2.8300   -3.4000   -3.1000   -2.8300   -3.4000   -3.1000
   -3.8000   -3.7000   -3.6100   -3.8000   -3.7000   -3.6100   -3.8000   -3.7000
   -3.9980   -3.9970   -3.9961   -3.9980   -3.9970   -3.9961   -3.9980   -3.9970
```

```
% bridge loan component of borrowing
ar_brdige_a = (ar_coh_bridge_perc'*ar_w_level)'
```

```
ar_brdige_a = 3×3
         0   -1.0000   -1.9980
         0   -0.5000   -0.9990
         0   -0.0500   -0.0999
```

```
ar_brdige_a = ar_brdige_a(:)'
```

```
ar_brdige_a = 1×9
         0         0         0   -1.0000   -0.5000   -0.0500   -1.9980   -0.9990 ···
```

```
% borrowing choices excluding bridge loan
mt_a_nobridge = mt_a - ar_brdige_a
```

```
mt_a_nobridge = 6×9
   -2.0020   -1.0030   -0.1039   -1.0020   -0.5030   -0.0539   -0.0040   -0.0040 ···
   -2.2000   -1.3000   -0.4900   -1.2000   -0.8000   -0.4400   -0.2020   -0.3010
   -2.6000   -1.9000   -1.2700   -1.6000   -1.4000   -1.2200   -0.6020   -0.9010
   -3.4000   -3.1000   -2.8300   -2.4000   -2.6000   -2.7800   -1.4020   -2.1010
   -3.8000   -3.7000   -3.6100   -2.8000   -3.2000   -3.5600   -1.8020   -2.7010
   -3.9980   -3.9970   -3.9961   -2.9980   -3.4970   -3.9461   -2.0000   -2.9980
```