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%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% This is the second part of question 3
% where we time the cholesky decomp, forsub, and backsub
% of B, B with rcm and B with amd
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

chol_time = zeros(3,1);             %time it takes to chol various matrices
forsub_time = zeros(3,1);           %time it takes to forsub various matrices
backsub_time = zeros(3,1);          %time it takes to backsub various matrices

labels = ["original"; "rcm";"amd"];

for N = [16 32 64 128 256];

    matrix = gallery('wathen',N,N);
    amd_matrix = matrix(symamd(matrix),symamd(matrix));
    rcm_matrix = matrix(symrcm(matrix),symrcm(matrix));

    tic
    chol_B = chol(matrix);
    chol_time(1,1) = toc;

    tic
    chol_rcm = chol(rcm_matrix);
    chol_time(2,1) = toc;

    tic
    chol_amd = chol(amd_matrix);
    chol_time(3,1) = toc;

    b = rand(size(matrix,1),1);

    tic
    y = chol_B'\b;
    forsub_time(1,1) = toc;

    tic
    chol_B\y;
    backsub_time(1,1) = toc;

    tic
    y = chol_rcm'\b;
    forsub_time(2,1) = toc;

    tic
    chol_rcm\y;
    backsub_time(2,1) = toc;

    tic
    y = chol_amd'\b;
    forsub_time(3,1) = toc;
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    tic
    chol_amd\y;
    backsub_time(3,1) = toc;

    disp("For a Wathen matrix of size " + N + " the timings are:")
    table(labels,chol_time, forsub_time, backsub_time)

end
```

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For a Wathen matrix of size 16 the timings are:

ans =

  3×4 table

      labels      chol_time     forsub_time    backsub_time
    __________    __________    ___________    ____________

    "original"       0.01267     0.0014125      0.00073075
    "rcm"          0.00092287     0.0001505      4.3292e-05
    "amd"           0.0010767    3.9334e-05      3.3959e-05

For a Wathen matrix of size 32 the timings are:

ans =

  3×4 table

      labels      chol_time    forsub_time    backsub_time
    __________    _________    ___________    ____________

    "original"    0.0098026     0.0002895      0.00026042
    "rcm"          0.010899    0.00032042      0.00018575
    "amd"         0.0027617    0.00011917      9.3958e-05

For a Wathen matrix of size 64 the timings are:

ans =

  3×4 table

      labels      chol_time    forsub_time    backsub_time
    __________    _________    ___________    ____________

    "original"     0.12099      0.0051725       0.0015352
    "rcm"          0.13087      0.0046642       0.0018777
    "amd"         0.023939     0.00099208      0.00049812

For a Wathen matrix of size 128 the timings are:

ans =

  3×4 table
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      labels       chol_time    forsub_time    backsub_time
    ___________    _________    ___________    ____________

    "original"      0.81112       0.061393       0.011748
    "rcm"            1.1554       0.031885       0.012329
    "amd"          0.092994      0.0043535      0.0022061

For a Wathen matrix of size 256 the timings are:

ans =

  3×4 table

      labels       chol_time    forsub_time    backsub_time
    ___________    _________    ___________    ____________

    "original"       13.037         2.9336          1.6057
    "rcm"            14.836         2.5037          1.2069
    "amd"           0.87747        0.17305        0.018949
```

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