AMSC/CMSC 661 Quiz 6 , Spring 2005

Show all work. You may leave arithmetic expressions in any form that a calculator could evaluate. By putting your name on this paper, you agree to abide by the university's code of academic integrity in completing the quiz. During the quiz you may use your textbook, my notes, and your own notes. No communication with others and no calculators or other electronic devices are permitted.

Name _____

1. (10) Suppose you want to solve a linear system of equations $Ax = b$, $n = 100,000$, and have your choice of 2 preconditioners for GMRES:

- M_1 creates a $\hat{G}_1$ with 5 small clusters of eigenvalues. 2 seconds and 10^6 storage locations are required to form $M_1^{-1}z$ for an arbitrary vector z.
- M_2 creates a $\hat{G}_2$ with 10 small clusters of eigenvalues. 1 second and 5×10^5 storage locations is required to form $M_2^{-1}z$ for an arbitrary vector z.

It takes .25 seconds and 10^6 storage locations to form Az. Which preconditioner would you advise using in order to compute an approximate solution to the problem? Why?

2. (10) The following is the Lanczos algorithm, closely related to CG. As usual, A is a matrix with nz nonzero elements and b is a vector of length n. How much storage does the algorithm use? How many multiplications and divisions does it perform? (Express your answers in terms of the parameters n, k, and nz.)

```
r=b;
beta = norm(b);
vsav=[];
beta0=beta;
v=zeros(n,1);

for i=1:k,

    vold=v;
    v=r/beta;
    av=A*v;
    alpha=v'*av;
    r=av-alpha*v-beta*vold;
    beta=norm(r);

    vsav=[vsav v];

    alphasav(i)=alpha;
    betasav(i)=beta;

end
```