

AMS 321: Computer Projects in Applied Mathematics

Project 2

Assignment Date: Wednesday (09/14/2009)

Collection Date: Wednesday (10/14/2009) 5PM

Grade: See Individual Problems

Do any two of the three problems below for full score for this project.

Doing all three is encouraged but only two are required

1. (5 Points) (1) Using two different methods to compute the following integral to achieve five digits of accuracy $\int_0^2 (\sin(x^7))^5 e^{-x^3} dx$. (2) Estimate the number of operations for each of the two methods for achieving such results.

2. (5 Points) The numbers defined by formula $P(m) = \frac{1}{6}m(m+1)(m-1)$ where $m > 1$ are called pyramidal numbers. It has been proved that any integer less than one billion can be expressed in the sum of no more than five such pyramidal numbers. In this project, you write a program to prove that the sum of no more than five such pyramidal numbers can express all integers less than 5000. Your report should contain,

- the description of the algorithm you used;
- a program with comments;
- a table that shows the least number of pyramidal numbers needed to represent integer 1-5000.

First, you have the following pyramidal numbers:

m	2	3	4	5	6	7	...
P(m)	1	4	10	20	35	56	...

And you can decompose integers as follows:

Int	Expressions	#pyramidal
1	= $[P(2)]$	1
2	= $[P(2)+P(2)]$	2
3	= $[P(2)+P(2)+P(2)]$	3
4	= $[P(3)]$	1
5	= $[P(3) + P(2)]$	2

...
...

Hint: You may refer to my papers at

<http://www.ams.sunysb.edu/~deng/paper%20with%20CCC%20on%20waring%20problems%20S0025-5718-97-00818-1.pdf>

<http://www.ams.sunysb.edu/%7Edeng/pubs.dir/yang-deng-waring1.pdf>

3. (5 Points) Download an English article from the web with at least 50,000 words. If one article is not long enough, you may download another one (not identical) to form one long article. In case you have to download two or more articles to form one long article, these individual articles don't have to be related in context. There is no specific constraint on what articles you may use, but you need to state clearly the source of your article. Here is what you need to do for the project (You should ignore all non-alphabets such as punctuation marks but keep only the 2×26 English alphabets in lower and upper cases.) Please write a program to

- (1) Count the usage frequencies of the alphabets (A--Z, a--z).
- (2) Make a list of the top 50 most frequently used words in the article.
- (3) Make a list of the top 25 most frequently used double-word phrases (such as "such as", "have to", "love you", "thank god"...) in the article.