HW 1

Due 23:00 September 14, 2017

CS ID:

Section (circle one):

Monday	L1J 9–11a	L1M 11a–1p	L1C 4–6p
Tuesday	L1A 11a–1p	L1F 4–6p	
Wednesday	L1B 9–11a	L1E 2–4p	L1M 6–8p
Thursday	L1D 10:30a–12:30p	L1G 4–6p	
Friday	L1K 1–3p	L1H 3–5p	

Please print out this document and write your solutions into the spaces provided. Show your work where necessary for full credit. If you require additional space, please indicate in the question space that you are writing on the last blank page, and also indicate on the blank page which question the work solves.

You must scan and upload the completed document, including this page and the last page, to GradeScope, using your 4- or 5-character CS ID.

1. (2 points) Using 140 characters or less, post a synopsis of your favorite movie to the course piazza space under the "HW1 tell me something!" notice, so that your post is visible to everyone in the class, and tagged by #HW1num1. Also, use Piazza's code-formatting tools to write a *private* post to course staff that includes at least 5 lines of code. It can be code of your own or from a favorite project—it doesn't even have to be syntactically correct—but it must be formatted as a code block in your post, and also include the tag #HW1num1. (Hint: Check http://support.piazza.com/customer/portal/articles/1774756-code-blocking). Finally, please write the 2 post numbers corresponding to your posts here:

Favorite Movie Post (Public) number:	
Formatted Code Post (Private) number:	

2. (12 points) Simplify the following expressions as much as possible, **without using an calculator (either hardware or software)**. Do not approximate. Express all rational numbers as improper fractions. Show your work in the space provided, and write your answer in the box provided.

(a) $\prod_{k=2}^{n}\left(1-\frac{1}{k^2}\right)$

Answer for (a):	

(b) $3^{1000} \bmod 7$

Answer for (b):	

(c) $\sum_{r=1}^{\infty}(\frac{1}{2})^r$

Answer for (c):	

(d) $\frac{\log_7 81}{\log_7 9}$

Answer for (d):	

(e) $\log_2 4^{2n}$

Answer for (e):	

(f) $\log_{17} 221 - \log_{17} 13$

Answer for (f):	

3. (8 points) Find the formula for $1 + \sum_{j=1}^{n} j!j$, and show work proving the formula is correct using induction.

Formula:	

4. (8 points) Indicate for each of the following pairs of expressions $(f(n), g(n))$, whether $f(n)$ is O, Ω, or Θ of $g(n)$. Prove your answers to the first two items, but just GIVE an answer to the last two.

   (a) $f(n) = 4^{\log_4 n}$ and $g(n) = 2n + 1$.

Answer for (a):	$f(n)$ $g(n)$

   (b) $f(n) = n^2$ and $g(n) = (\sqrt{2})^{\log_2 n}$.

Answer for (b):	$f(n)$ $g(n)$

(c) $f(n) = \log_2(n!)$ and $g(n) = n \log_2 n$.

Answer for (c):	$f(n)$ $\qquad$ $g(n)$

(d) $f(n) = n^k$ and $g(n) = c^n$ where k and c are constants and $c > 1$.

Answer for (d):	$f(n)$ $\qquad$ $g(n)$

5. (10 points) For each C++ function below, give the tightest asymptotic upper bound that you can determine.

(a)

```
void mochalatte(int n) {
  for (int i = 0; i < n; i++) {
    cout << "iteration: " << i << endl;
  }
}
```

Answer for (a):	

(b)

```
void nanaimobar(int n) {
  for (int i = 0; i < 2*n; i = 2*i) {
    cout << "iteration: " << i << endl;
  }
}
```

Answer for (b):	

(c)

```
void appletart(int n) {
  for (int i = 0; i < 3*n; i = i+3) {
    for (int j = 0; j*j < 2*n; j++) {
    cout << "iteration: " << j << endl;
    }
  }
}
```

Answer for (c):	

(d)

```
void chococheesecake(int n) {
  for (int i = 1; i <= n; i++) {
    if (i >= n) {
      for (int j = 0; j < 2*n; j++) {
        nanaimobar(n);
      }
    }
  }
}
```

Answer for (d):	

(e)

```
void tiramisu(int n) {
  for (int i = 0; i < n; i++) {
     if (i%2 == 0)
        chococheesecake(i);
     else
        cout << "iteration: " << i << endl;
  }
}
```

Answer for (e):	

Blank sheet for extra work.