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ECGR 3180
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Assignment 1 - Problem 3

3. (20 pts) For each one of the loops below, give a Big-Oh analysis of the running time. Show work/reasoning.

```
a) sum = 0;
   for (i = 0; i < n; ++i)
          ++sum;
```

O(n)
for loop runs n times in total from 0 to n-1

```
b) sum = 0;
   for (i = 0; i < n; ++i)
          for (j = 0; j < n; j++)
                 ++sum;
```

O(n^2)
outer loop runs total n times, for each outer loop n times of run inner loop runs n times also.

$Total = n \times n = n^2$

```
c) sum = 0;
   for (i = 0; i < n; ++i)
          for (j = 0; j < n*n; ++j)
                 ++sum;
```

O(n^3)
outer loop need n times to run, for each outer loop, inner loop need n^2 times to run.

$Total = n \times n^2 = n^3$

```
d) sum = 0;
   for (i = 0; i < n; ++i)
          for (j = 0; j < i; ++j)
                 ++sum;
```

O(n^2)
outter loops runs n times, inner times runs up to i times. When i = n-1, inner loop runs n-1 times.

$Total = \frac{n \times (n-1)}{2} = \frac{n^2-n}{2} = n^2$

```
e) sum = 0;
   for (i = 0; i < n; ++i)
          for (j = 0; j < i * i; ++j)
                 for (k = 0; k < j; ++k)
                        ++sum;
```

O(n^4)
outer loop runs n times and for each mid loop runs, then inner loop runs up to i^2 times

$Total = n \times \frac{(n)(n+1)(2n+1)}{6} = n^4$

```
f) sum = 0;
   for (i = 1; i < n; ++i)
          for (j = 1; j < i * i; ++j)
                 if (j % i == 0)
                        for (k = 0; k < j; ++k)
                               ++sum;
```

O(n^4)
outer loop runs in n-1 times, and for each outer loop mid loop runs up to I^2 times, then inner loop runs for each even j.

$Total = \frac{n(n+1)(2n+1)}{6} \times \frac{n}{2} = n^4$