Problem 1 - Order Notation

a) Prove $\frac{1}{n} \in o(1)$

b) Prove $2^{\log^2 n} \in \omega(n)$

c) Prove $\log(n!) \in \Omega(n \log(n))$

Problem 2 - Separate Bounds

Prove this algorithm is in $\Theta(n^2)$ by proving separate upper and lower bounds.

```plaintext
sum := 0
for i=1 to n
    for j=1 to i
        sum = sum + (i - j)^2
    sum = sum/i
return sum
```

Problem 3 - More Algorithms Analysis

Analyze the runtime of the algorithm below and prove a $\Theta$ bound.

```plaintext
for i=1 to n
    j := i
    while j < n do
        j = 2*j

Hint: Stirling’s formula states that $n! \approx \sqrt{2\pi n} \left(\frac{n}{e}\right)^n$
```
Problem 4 - Heap Insert and Delete

Insert 17, then 8 on the heap below. Then perform delete-max on the original heap.