Syllabus for CS111 Quiz 1

- Summation formulas, computing closed forms, arithmetic and geometric sequences. Examples:
  - Give a formula for $\sum_{i=1}^{n+5} i$. Express it as a polynomial function of n.
  - Give a formula for $\sum_{i=2}^{2n}(2i+1)$. Express it as a polynomial function of n.
  - Give a formula for $\sum_{i=1}^{2n} 3^i$.
  - Determine the numerical value of $\sum_{i=1}^{10} 2^i$. You must use the formula for the sum of a geometric sequence.

- Proofs by induction. Examples:
  - Prove by induction that $\sum_{i=1}^{n} i^2 = \frac{1}{6}n(n+1)(2n+1)$, for $n \geq 0$.
  - Prove by induction that $\sum_{i=2}^{n}(2i-1) = n^2 - 1$, for $n \geq 1$.
  - Prove by induction that $3^n \geq 2^n + n^2$ for $n \geq 0$. You can use inequality $3n^2 \geq (n+1)^2$, for $n \geq 2$.

- Asymptotic notation: big-Oh, Omega, and Theta. Estimating asymptotic values of functions. Asymptotic estimates of running time. Logarithmic, polynomial, and exponential functions, and relations between then. Examples:
  - Give the Θ-estimate of function $f(n) = 4n^3 + \sqrt{n^7}\log n$. Provide a brief informal justification (at most 10 words).
  - Give a complete definition of the big-Oh notation, namely what does it mean that $f(n) = O(g(n))$.
  - Using the definition of big-Oh notation, prove that $3n^2 + n + 7 = O(n^2)$. Only proofs based on the definition will be accepted.
  - Let $f(n) = 8^{\log_3 n}$. Is it true that $f(n) = O(n^3)$? Is it true that $f(n) = \Omega(n^2)$? Justify your answer.
  - You are given a piece of pseudo-code below ... . Express the running time of this code using Theta notation. Justify your answer.