1. In class we mostly worked with DFT for the case where $n$ is a power of 2, and the polynomial being evaluated has degree $n - 1$. However, we also showed that we can apply the DFT and Inverse DFT when $n$ is not a power of 2, by taking $n'$ to be the closest power of 2 satisfying $n \leq n'$, and adding some leading coefficients of value 0.

Make this idea formal - first show how to compute $n'$. Also show that our DFT or Inverse DFT still takes $\Theta(n \lg(n))$ time in terms of the original value $n$.

2. This exercise asks you to do a few complex number calculations. Evaluate each of these, using the rules for multiplication and division that I gave you in the FFT notes.
   
   (a) $2i(3 - i)$.
   (b) $2i(i + 1)^2 + 4(i + 1)^3$.
   (c) $3i/(1 + i)$.

3. Compute DFT$_4$\{0, 1, 2, 3\}. (do this directly, rather than by FFT, if you prefer).

   This is Exercise 30.2-2, p. 838 of [CLRS].

4. Use the FFT to efficiently multiply the two polynomials $p(x) = x - 4$ and $q(x) = x^2 - 1$.

What I mean by this is:

   (a) First work out what will be the degree of the product polynomial $pq$. Take $\deg(pq) + 1$ as our $n$ (and if necessary round up to the nearest power of 2).
   (b) For this value of $n$ (which we made sure was a power of 2), use trigonometry to write down each of the $n$th roots-of-unity (so we have them to work with).
   (c) Calculate the DFT for $p(x)$ for $n$th roots of unity.
   (d) Calculate the DFT for $q(x)$ for $n$th roots of unity.
   (e) Do pointwise multiplication of the two DFTs to get the DFT of $pq(x)$ for $n$th roots of unity.
   (f) Calculate the Inverse DFT of the DFT for $pq(x)$, to obtain the polynomial $pq$.
      It’s a good idea to do this via DFT (and then swapping), like we saw in class.
   (g) Check your answer by straight multiplication.