21-320 Homework Set 2

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Due Mon 7 February.

1. Construct a 10×10 matrix `A` such that `A[i, j] = x^i + y^j` for $1 \leq i, j \leq 10$.

2. Executing `subs(a=b,c)` replaces all occurrences of `a` in the expression tree for `c` by `b`. With this in mind explain the results of `subs(1=-1,1/x)` and `subs(-1=1,1/x)`.

3. Read the online help for `add`. We define for $n \geq 0$ a function

$$f_n(x) = \sum_{i=0}^{n} (-1)^i \frac{\cos((2i+1)x)}{2i+1}.$$

   Plot the graphs of $f_1, f_{10}, f_{100}, f_{1000}$ in the range $[-2\pi, 2\pi]$. Speculate about the behaviour of the function f_n for large n.

4. For which real values of a does the polynomial $x^2 + ax + 1$ have real roots? Draw a graph showing the behaviour of these roots as a function of a for $|a| \leq 5$.

5. The graph of $y = \cos(x)$ (for $0 \leq x \leq 4\pi$) is rotated around the y-axis to generate a surface. Plot that surface.

6. A map F from the xy-plane to itself is defined by $F(x, y) = (e^x \cos(y), e^x \sin(y))$. Plot the image under F of the square whose four corners lie at $(1, 1)$, $(3, 2)$, $(2, 4)$, $(0, 3)$.