ACTIVITIES AND COURSES IN MATHEMATICAL STUDIES WITH PROGRAMMING

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PROGRAMMING IS A LANGUAGE THAT HAS MATHEMATICAL CONNECTIONS

WHY PROGRAM IN MATH CLASS

- A program is an algorithm that requires clear step-by-step instructions.
- Math and programming are languages that require correct notation.
- Programming allows students to positively and productively fail.
- Programming provides a path to work with robotics.
- Programming is used in more than just math and science, for example in music the scales can be programed for electronic devices.
- State math standards are addressed in programming.

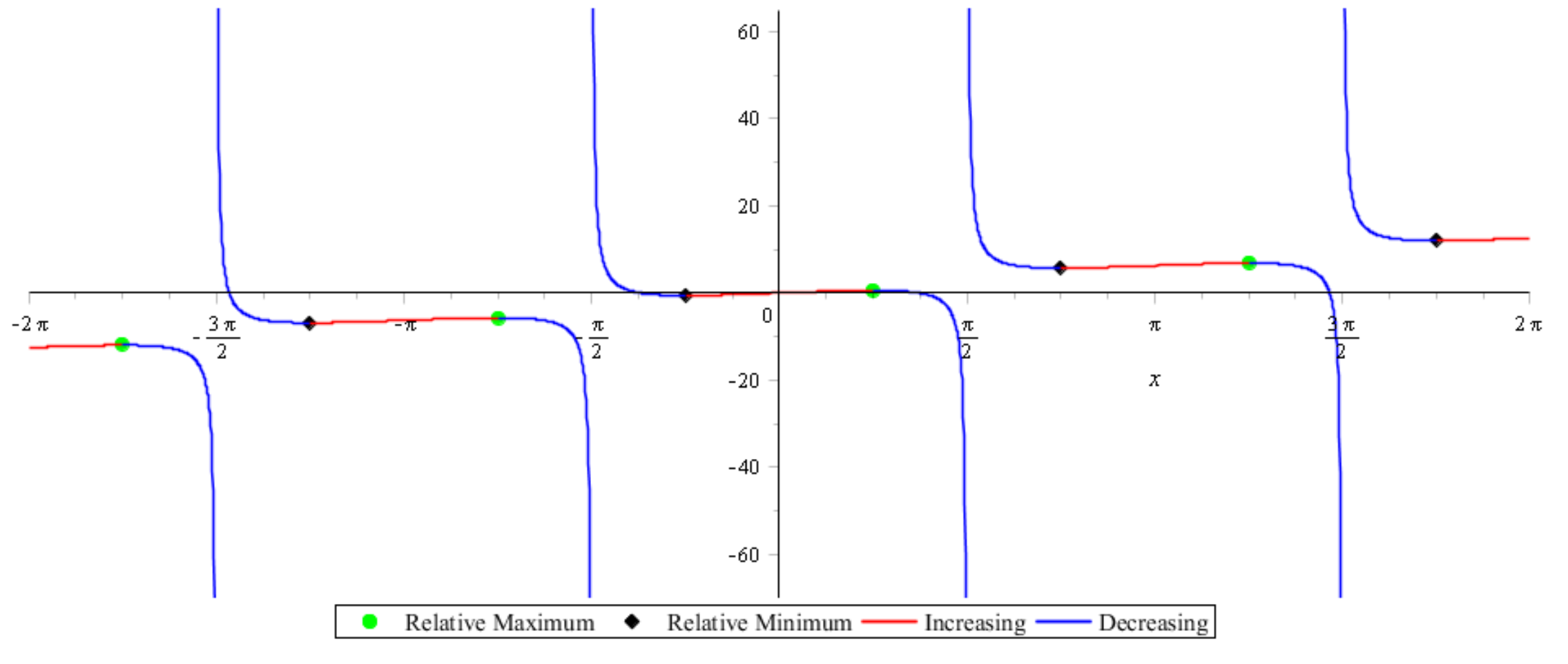
MN STATE MATH STANDARDS AND BENCHMARKS RELATED TO PROGRAMMING:

- Standard 9.3.2 – Construct logical arguments
- Benchmark: 9.3.2.2 Logical Relationships - Accurately interpret and use words and phrases such as "if...then," "if and only if," "all," and "not."
- Benchmark: 9.3.2.3 Validity of a Logical Argument - Assess the validity of a logical argument and give counterexamples to disprove a statement.
- Benchmark: 9.3.2.5 Technology Tools - Use technology tools to examine theorems, make and test conjectures, perform constructions and develop mathematical reasoning skills in multi-step problems

PROGRAMMING AS PART OF MATH CLASSES

- Computer Calculus - Programming in Maple
- Programing in LaTeX
- Programing in R
- TI-Graphing Calculators

MAPLE USED TO ANALYZE $f(x) = 1 - \tan(x)^2$



TIPS FOR USING MAPLE

- Include multiplication operation symbol between variables as 5*x* is not 5**x*.
- When you define an equation you need to begin with the notation for that program which is "*f*(*x*) :="
- When using a range in a graph you need "1 ..10" for 1 to 10, note not ...
- Different packages are needed for different commands through "with(name of package):"
- The search provides multiple possible possibilities
- There are pre-created worksheets/activities that teachers can use

EXAMPLES OF LATEX

1. The Rieman integral is often defined in Calculus books as $\lim_{n\to\infty}\sum_{i=1}^{n} f(x_i)(\Delta x_i) = \int_a^b f(x)dx.$

2. (a) $\lim_{x\to 3}\left(5x^2 - 7x + 2\right)$

   (b) $\lim_{x\to 5}\left(\frac{x^2-25}{x^2-6x+5}\right)$

   (c) $\lim_{x\to\infty}\left(\tan^{-1}(x)\right)$

CODE IN LATEX

```
\begin{enumerate}

    \item The Rieman integral is often defined in Calculus books as $\di \lim_{n\rightarrow \infty} \sum_{i=1}^{n} f(x_i)(\Delta x_i)=\int_{a}^{b}{f(x)dx}$.

    \item

        \begin{enumerate}

        \item $\di \limfnc{3}{5x^2-7x+2}$

        \item $\di \limfnc{5}{\frac{x^2-25}{x^2-6x+5}}$

        \item \di \limfnc{\infty}{\tan^{-1}(x)}

        \end{enumerate}
```

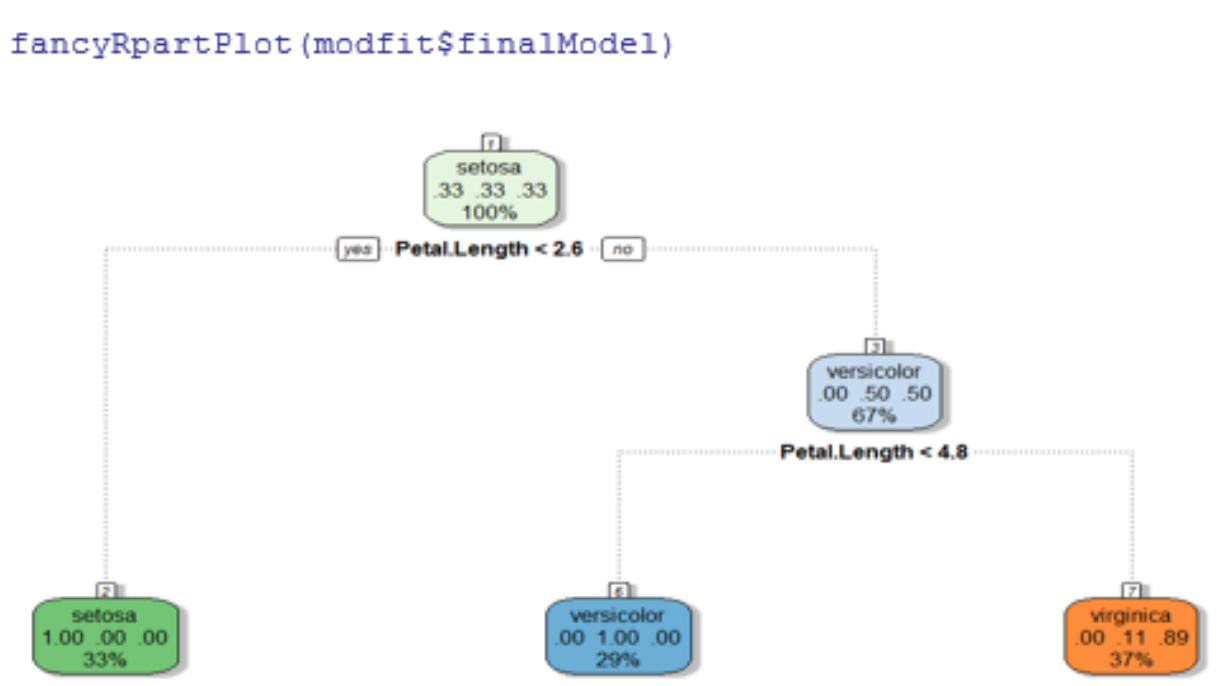
EXAMPLES OF LATEX

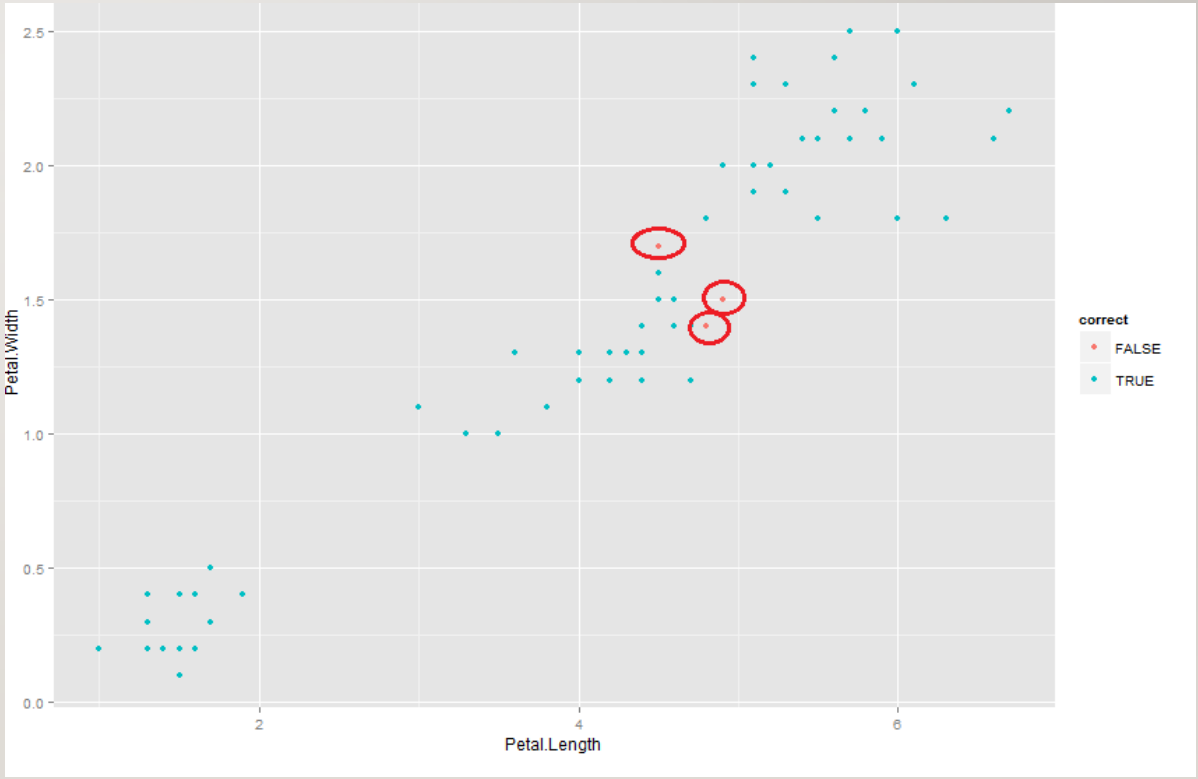
```
\documentclass{article}

\usepackage{enumerate,multicol,hyperref,amsmath,amsthm}

\setlength{\topmargin}{0in}

\setlength{\oddsidemargin}{-.75in}

\setlength{\textheight}{9.5in}

\setlength{\textwidth}{7.5in}
```

TIPS FOR PROGRAMMING LATEX

- Those darn backslashes when to use \ vs /
- Comment options through the use of $ to start a line that is not compiled
- The Start and End are commands that can not be forgotten
- Load packages that use commands that are not part of the standard program
- Some packages take a good deal of time (up to 30 min.) to load
- Parenthesis must be paired for the program to understand your notation

WORKING WITH DECISION TREES IN R

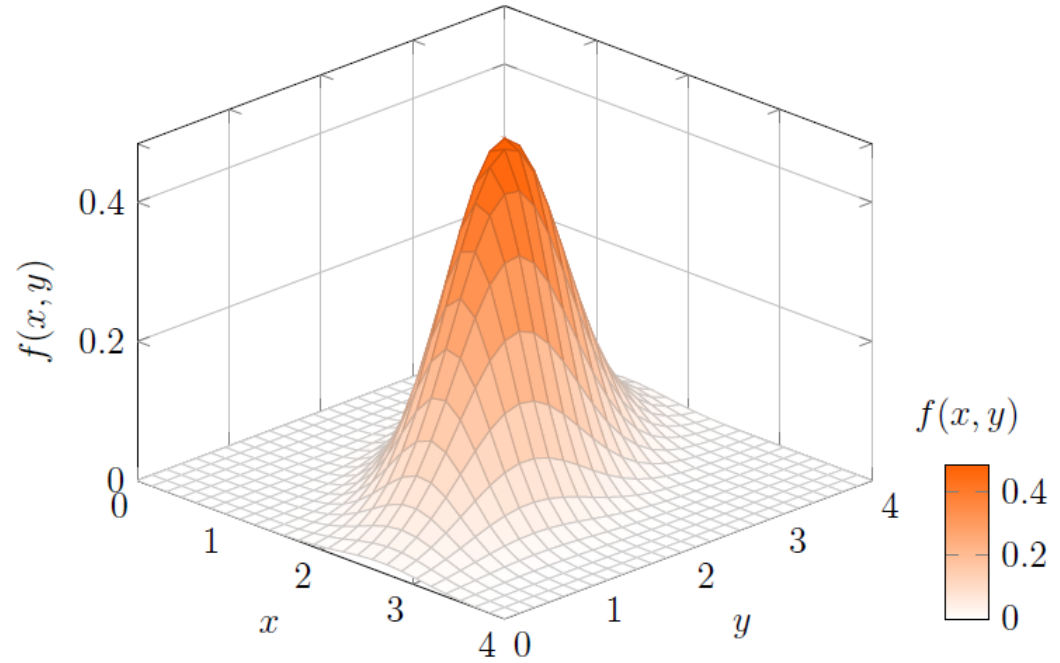




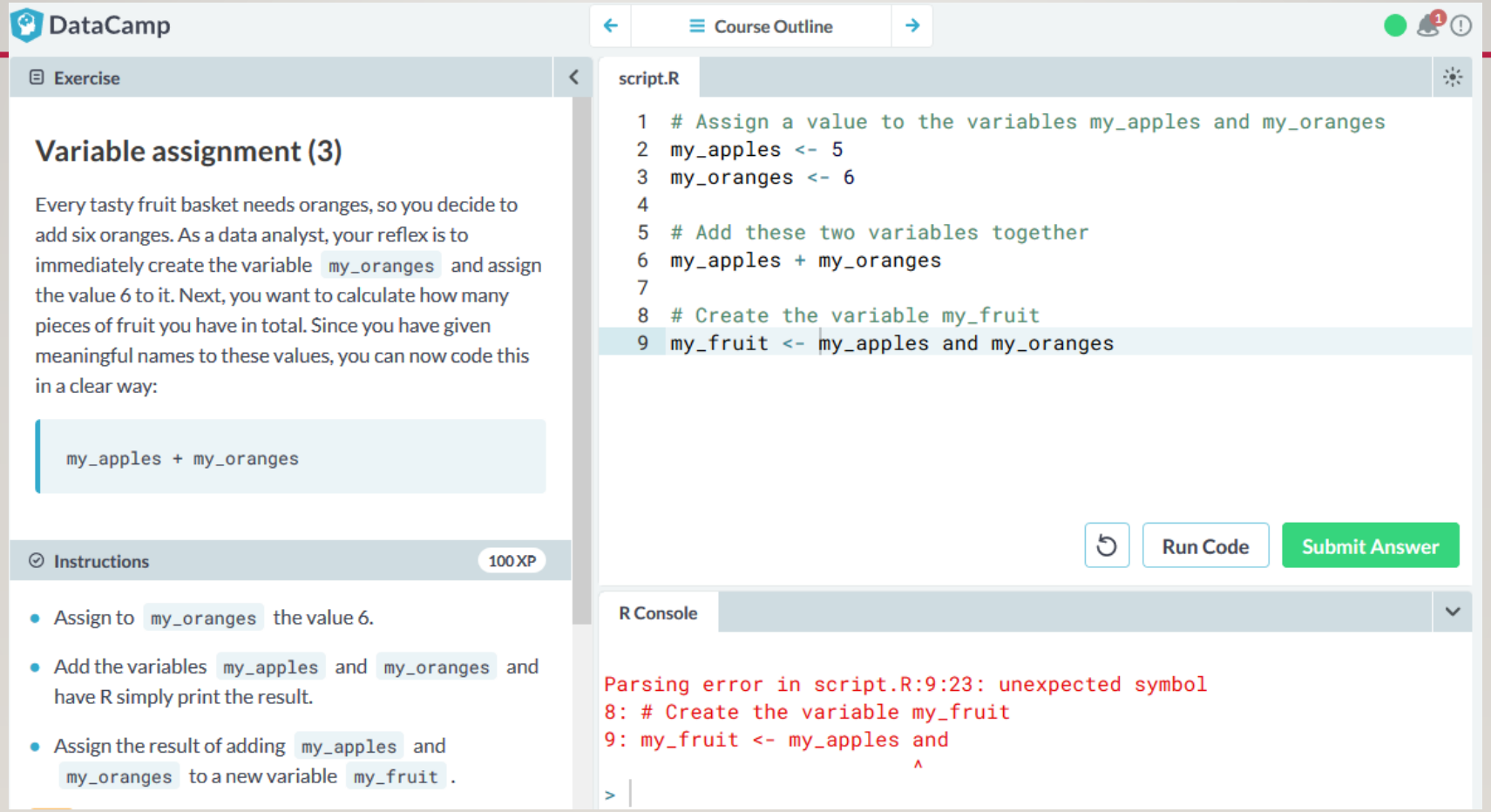
BIVARIATE NORMAL DISTRIBUTION

$$f(x,y) = \frac{1}{2\pi\sigma_1\sigma_2\sqrt{1-\rho^2}} \exp\left\{-\frac{1}{2(1-\rho^2)}\left[\left(\frac{x-\mu_1}{\sigma_1}\right)^2 - 2\rho\left(\frac{x-\mu_1}{\sigma_1}\right)\left(\frac{y-\mu_2}{\sigma_2}\right) + \left(\frac{y-\mu_2}{\sigma_2}\right)^2\right]\right\}$$

Note that there are five parameters: $\mu_1, \mu_2, \sigma_1, \sigma_2, \rho$. When X and Y are jointly normally distributed, each of the two variables is normally distributed.



GETTING STARTED WITH R PROGRAMMING



PROGRAMMING THE TI-GRAPHING CALCULATOR

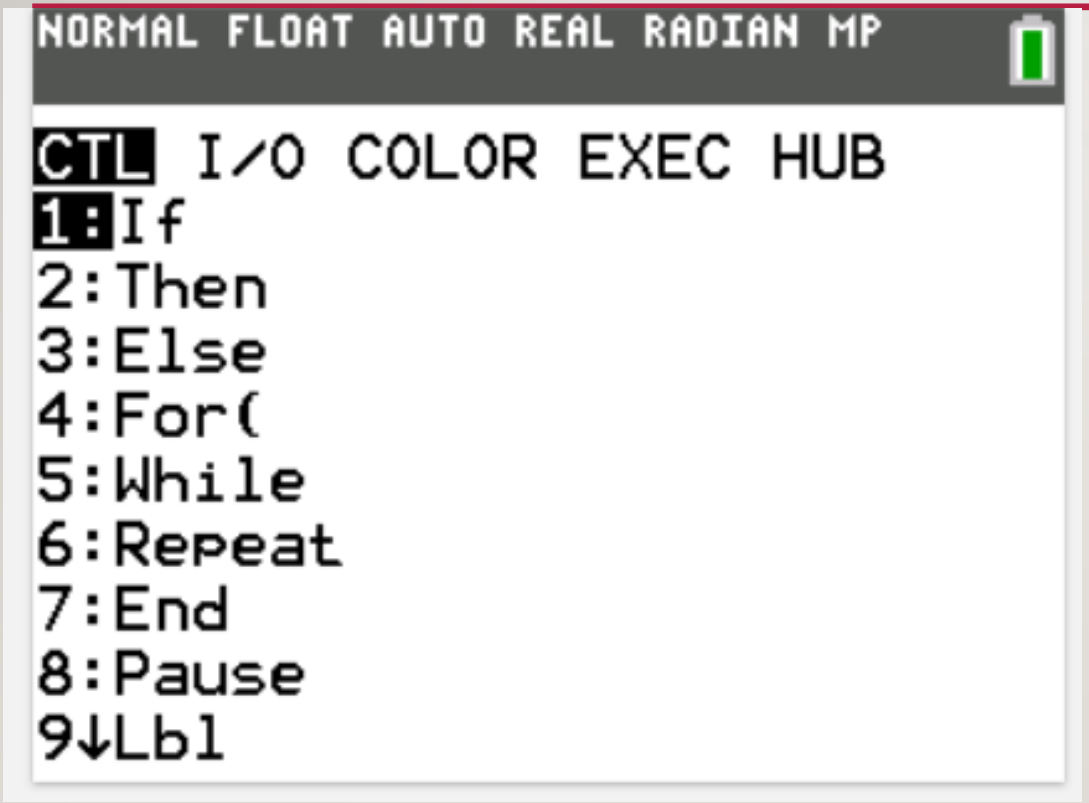
- Slope
- Law of Sines and Cosines
- Quadratic formula
- Arc Length
  - Angle Measure, Radius, Arc Measure

PROGRAMMING THE TI-84 TO DIRECT THE TI-INNOVATOR HUB

TI-84 KEYBOARD

In the 4th row down third column over select Program.

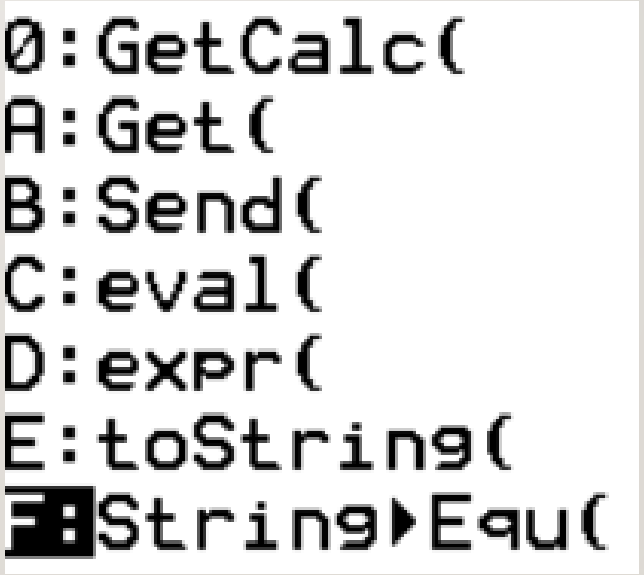
CONTROL PROGRAMMING COMMANDS



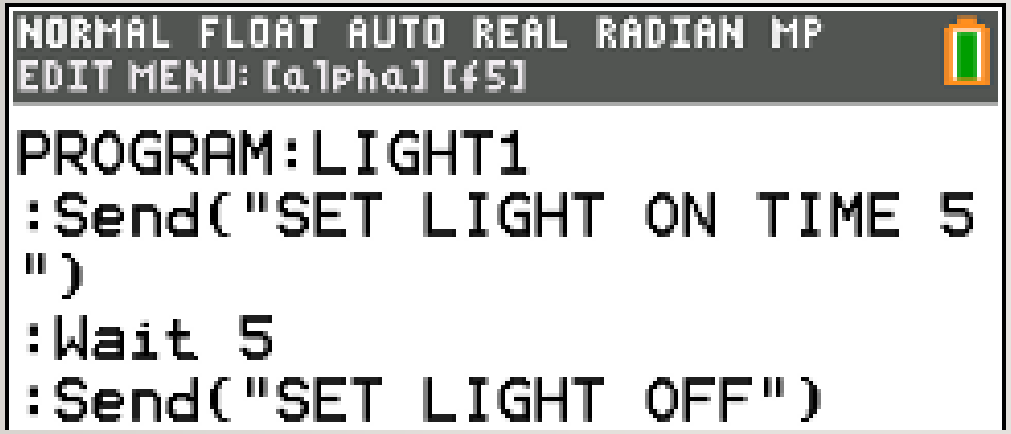
Scrolling past the first 9 gets you to the following:

INPUT/OUTPUT PROGRAMMING COMMANDS

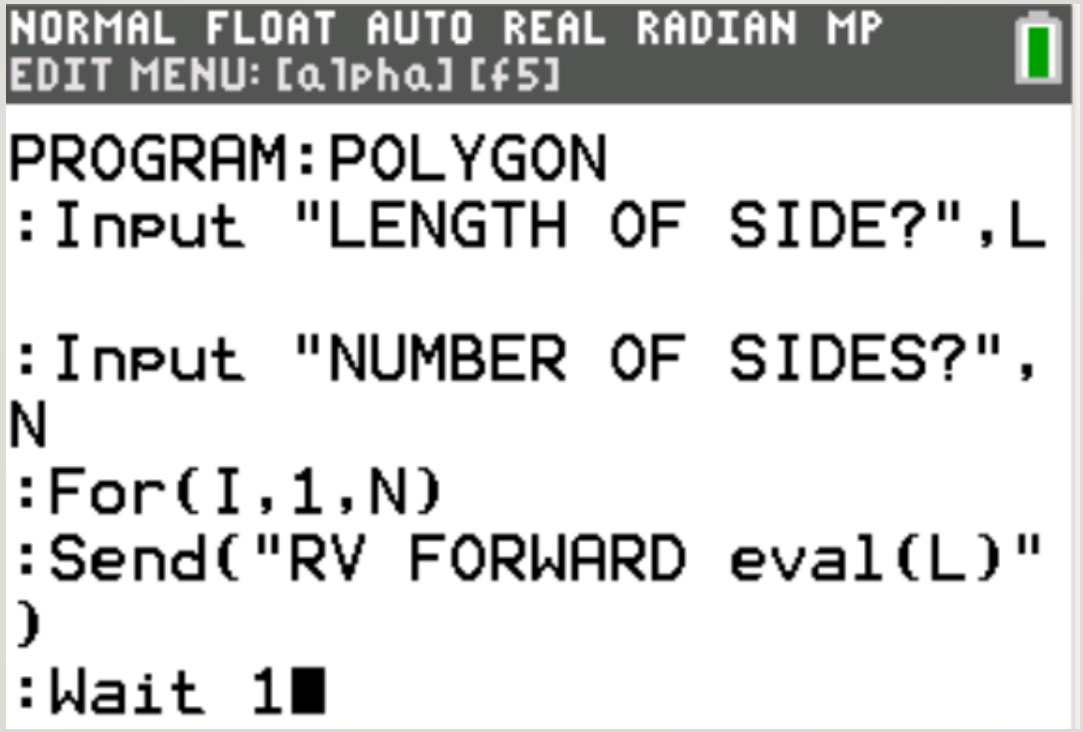
Scrolling past the first 9 gets you to the following:



LIGHT UP THE TI-INNOVATOR HUB



ROVER PROGRAMMING - POLYGON



TECHNICAL ISSUES TO BE AWARE OF:

- Turn Rover on and make sure it is charged up (See front of rover)
- Plug in all wires/cords firmly (*include line for checking connection*)
- The calculator's operating system must be OS TI-84 Plus CE v5.3 or higher, TI-Nspire CX OS v4.5 in order correctly communicate with the TI-Innovator Hub
- Syntax must include correct spelling of commands

WHAT COMES NEXT FOR THE PROGRAM TO DIRECT THE ROVER TO CREATE A POLYGON?

WHAT DO THESE COST?

- Maple 10 Student Edition $99 and Maple 2019 Academic $995
- LaTeX $0
- R $0
- TI-84 Plus CE Graphing Calculator $127 or Nspire CX CAS Handheld $135
- TI-Innovator / Rover $120
- TI-Innovator Hub Kit $60
- The Bach Company http://www.bachcompany.com/

RECOMMENDED RESOURCES

- Overleaf for LaTeX programming https://www.overleaf.com
- DataCamp free introduction to R https://campus.datacamp.com/courses/free-introduction-to-r
- 10 Minutes of Code for TI products https://education.ti.com/en/activities/ti-codes
- TI-Smartview https://education.ti.com/en/downloads
- Math Class Calculator https://mathclasscalculator.com/index.php/programing/

Email harms@mnstate.edu and http://web.mnstate.edu/harms/