CS368 MATLAB Programming

Lecture 10

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Based on lecture slides by Michael O’Neill and Beck Hasti

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Multiple Choice Quiz
Indicator Variables

Math

- If the same task is performed for different values of a variable, use an indicator variable and vectorize.
- If different tasks are performed for different values of a variable, use a `switch` conditional.
- If different tasks are performed under different conditions, use an `if` conditional.
Different tasks are performed for $x = v_1$, for $x = v_2$ or $v_3$, and for every other value of $x$.

```
switch x
  case v1
  ... 
  case \{v2, v3\}
  ... 
  otherwise
  ... 
end
```
Different tasks are performed if $x \neq 0$, if $x = 0$ but $y \neq 0$, and if $x = 0$ and $y = 0$.

```plaintext
1  if x
2     ...
3  elseif y
4     ...
5  else
6     ...
7  end
```
**Condition for If**

*Code*

- *if* \( x \) and *if* \( x \neq 0 \) represent the same condition. The expression *if* \( x \neq 0 \) should be treated as a variable whose value is:
  \[
  \begin{cases}
  1 & \text{if } x \neq 0 \\
  0 & \text{if } x = 0 
  \end{cases}
  \]

- *while* \( x \) and *while* \( x \neq 0 \) represent the same loop for the same reason.
Conditionals, Switch

Quiz
Conditionals, If Quiz
Conditionals, Variable as Condition

Quiz
Number of Input Arguments

Code

- When the function `function z = f(x, y)` is called, 0, 1 or 2 arguments can be provided.
- `switch` can be used here to perform different tasks when different number of arguments are given.
- `nargin` is the number of input arguments provided when the function is called.
For example, a new log function can be defined by \texttt{log()} returns 1, \texttt{log(x)} returns natural log (x), and \texttt{log(n, x)} returns log$_n$(x).

\begin{verbatim}
function z = log(x, y)
switch nargin
  case 1
    z = log(x);
  case 2
    z = log(y) / log(x);
  otherwise
    z = 1;
end; end
\end{verbatim}
Variable Length Input Argument

Code

- \textit{varargin} represents an arbitrary number of input variables.
- It can only be used as the last argument of a function, for example, \textit{function } \( y = f(x_1, x_2, x_3, \text{ varargin} ) \).
- The \( i \)-th argument can be accessed by \textit{varargin} \{ \textit{i} \}.
For example, a new log function can be defined so that it returns a vector if more than one input is provided.

```
function z = log(x, varagin)
    if nargin == 1
        z = log(x);
    else
        z = [log(x) zeros(1, nargin - 1)];
        for t = 2:nargin
            z(t) = log(varagin{t - 1});
        end; end; end
```
Output Arguments
Code

- `varargout` represents an arbitrary number of output variables.
- `nargout` represents the number of output variables assigned when the function is called.
- For example, `x = size([1 2; 3 4])` assigns `x` the value `2 2` and `[x, y] = size([1 2; 3 4])` assigns `x` the value `2`.
Recursion
Math

A function that uses itself in the body is called a recursive function.

1. function $z = f(x)$
2. if $x$ ... % base case
3. $z = ...$
4. else % recursion
5. $z = ... f(x') ...$
6. end
Recursion Example, Factorial

Code

To compute the factorial of $n \geq 0$:

1. \textit{function} $z = f(x)$
2. \textit{if} $\neg x$
3. \hspace{1em} $z = 1$;
4. \textit{else}
5. \hspace{1em} $z = x \times f(x - 1)$;
6. \textit{end}
7. \textit{end}
To compute the sum of the values in a vector $v$:

```matlab
function z = f(x, t)
    if nargin == 1
        z = f(x, 0);
    elseif t > length(x)
        z = 0;
    else
        z = x(t) + f(x, t + 1);
    end
end
```
Recursion, Fibonacci

Quiz
Recursion, Binomial

Quiz
Recursion, Greatest Common Divisor

Quiz
Recursion, Greatest Common Divisor Again

Quiz
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