Multiple Choice

Quiz

Which answer(s) is correct?

A: All of the below.
B: None of the below.
C: All of the above.
D: One of the above.
E: None of the above.
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

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

- \textit{while} $x$ and \textit{while} $x \sim= 0$ represent the same loop for the same reason.
Conditionals, Switch

Quiz

```
x = 10; switch mod(x, 4)
  case 0
    x + 1
  case {1, 2}
    x * 2
  otherwise
    x ^ 3
end
```

- A : 11
- B : 20
- C : 1000
x = 10;
if x < 10 && ~mod(x, 2)
  x + 1
elseif ~mod(x, 3)
  x * 2
else
  x ^ 3
end

A : 11
B : 20
C : 1000
Conditionals, Variable as Condition

Quiz

1. \( x = 0; \ y = 1; \ z = 2; \)
2. \( \text{if } x \&\& \sim y \&\& z \)
3. \( x \)
4. \( \text{elseif } x \mid\mid \sim y \mid\mid z \)
5. \( y \)
6. \( \text{else} \)
7. \( z \)
8. \( \text{end} \)

- \( A : 0 \)
- \( B : 1 \)
- \( C : 2 \)
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 \( \text{log}() \) returns 1, \( \text{log}(x) \) returns natural \( \text{log}(x) \), and \( \text{log}(n, x) \) returns \( \text{log}_n(x) \).

```
function z = log(x, y)
    switch nargin
    case 1
        z = log(x);
    case 2
        z = log(y) / log(x);
    otherwise
        z = 1;
    end; end
```
**Variable Length Input Argument**

**Code**

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

```matlab
function z = log(x, varargin)
    if nargin == 1
        z = log(x);
    else
        z = [log(x) zeros(1, nargin - 1)];
        for t = 2:nargin
            z(t) = log(varargin{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, \( x = \text{size}([1 \ 2; \ 3 \ 4]) \) assigns \( x \) the value \( 2 \ 2 \) and \( [x, \ y] = \text{size}([1 \ 2; \ 3 \ 4]) \) assigns \( x \) the value \( 2 \).
A function that uses itself in the body is called a recursive function.

```matlab
function z = f(x)
    if x ... % base case
        z = ...
    else % recursion
        z = ... f(x') ...
    end
```
Recursion Example, Factorial

Code

- To compute the factorial of \( n \geq 0 \):

```matlab
function z = f(x)
    if ~x
        z = 1;
    else
        z = x * f(x - 1);
    end
end
```
Recursion Example, Vector Sum

Code

To compute the sum of the values in a vector v:

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

Quiz

1. \( \text{function } z = \text{fib}(x) \)
2. \quad \text{if } x < 3
3. \quad \quad z = 1;
4. \quad \text{else}
5. \quad \quad z = \text{fib}(x - 1) + \text{fib}(x - 2);
6. \quad \text{end}
7. \text{end}
8. \text{fib}(5)

- A : 5
- B : 7
Recursion, Binomial

Quiz

```matlab
function z = combin(x, y)
    if y == 0 || y == x
        z = 1;
    else
        z = combin(x - 1, y) + combin(x - 1, y - 1);
    end
end

combin(3, 2)
```

- A: 3
- B: 6
Recursion, Greatest Common Divisor

Quiz

1. \textit{function} \ z = \gcd(x, \ y) \\
2. \quad \textit{if} \ y == 0 \\
3. \quad \quad z = x; \\
4. \quad \textit{else} \\
5. \quad \quad z = \gcd(y, \ \text{mod}(x, \ y)); \\
6. \quad \textit{end} \\
7. \textit{end} \\
8. \gcd(10, \ 6) \\
   \begin{itemize}
   \item A : 2 \\
   \item B : 6
   \end{itemize}
Recursion, Greatest Common Divisor Again

Quiz

1. function $z = gcd(x, y)$
2. \hspace{1em} if $y == 0$
3. \hspace{2em} $z = x$;
4. \hspace{1em} else
5. \hspace{2em} $z = gcd(y, \text{mod}(x, y))$;
6. \hspace{1em} end
7. end
8. $gcd(9, 16)$
   - $A: 1$
   - $C: 9$
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