Anti-Patterns:
- No worst case stack size analysis
- Use of recursion
- No memory protection for stack

The stack stores data for subroutines
- Automatic (non-static) variables
  - Also, subroutine & interrupt register saves
- Calls put data on stack
  - Interrupts & RTOS calls put data on stack too
- But what if the stack overflows?
  - Need to handle worst-case stack size
If stack gets too big, it stomps on other memory: **Stack Overflow**

- Can corrupt static variables and globals
- Can corrupt RTOS data structures
  - System-wide task information corruption

Can cause system crashes

- Worse, can cause subtle system corruption
  - Task death, task period alteration
  - Security exploits via access to OS data

**Stack Overflow Corrupts Memory**
Prevent & Detect Stack Overflow

Preferred approaches:
- Static analysis of stack depth
  - Tool can figure out maximum depth
  - MMU hardware memory protection

At Run-Time: Stack Sentinels
- At system start, fill stack with a sentinel value (e.g., 0xAA44CC33)
- Program execution writes to stack
  - Sentinels permanently overwritten
- Periodically check to see how many sentinels are left (stack size margin)
Best Practices For Avoiding Stack Overflow

- **Determine worst case stack depth**
  - Sentinels are a good start
  - But you might not see true worst-case depth in testing
  - Worst-case stack depth for deeply nested calls + safety margin
  - Use a tool if you have one, or use a disassembler
    - PLUS: Biggest interrupt service routine stack use
    - PLUS: RTOS call use of stack (can be significant)

- **Protect stack at run time**
  - Use MMU hardware protection if you have it
  - Use sentinels & periodic check to detect stack overflow
    - Also helps with experimental confirmation of depth analysis

- **Avoid recursion – makes worst case problematic**
  - Be mindful that big data structures can make stack big