

Homework 2-3

- Program 1

The screenshot displays the Atmel Studio IDE interface for debugging a program on an ATmega328P microcontroller. The main window shows the disassembly of the assembly file `main.asm`. The code is as follows:

```

;Program 1 static
; Replace with your application code
.include "m328pdef.inc"
.def VAR_I = r16
.def VAR_J = r17
.def VAR_K = r18

.cseg
.org 0x00
ldi x1,low(ptn_i)
ldi xh,high(ptn_i)
ld VAR_I,x+
ld VAR_J,x+
ld VAR_K,x+

ldi VAR_I,3
ldi VAR_J,12
ldi VAR_K,20
mov VAR_I,VAR_J
add VAR_I,VAR_K
inc VAR_K
mov VAR_J,VAR_K
subi VAR_J,5

STORE: ldi z1,low(ptn_j)
ldi zh,high(ptn_j)
st z+,VAR_I
st z+,VAR_J
st z+,VAR_K

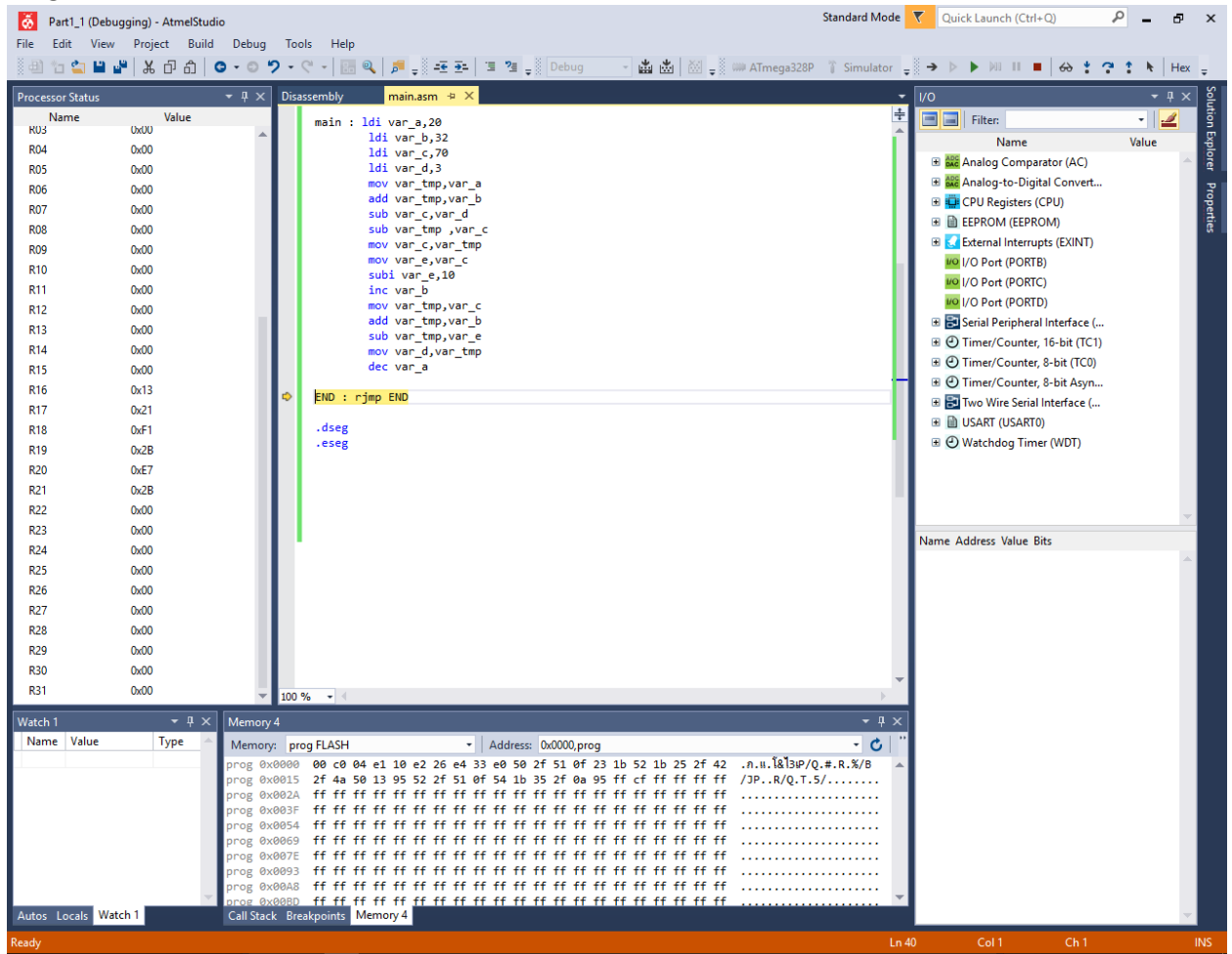
END: rjmp END

.dseg
.org 0x0100
ptn_i: .byte 1
ptn_j: .byte 1
ptn_k: .byte 1
.eseg

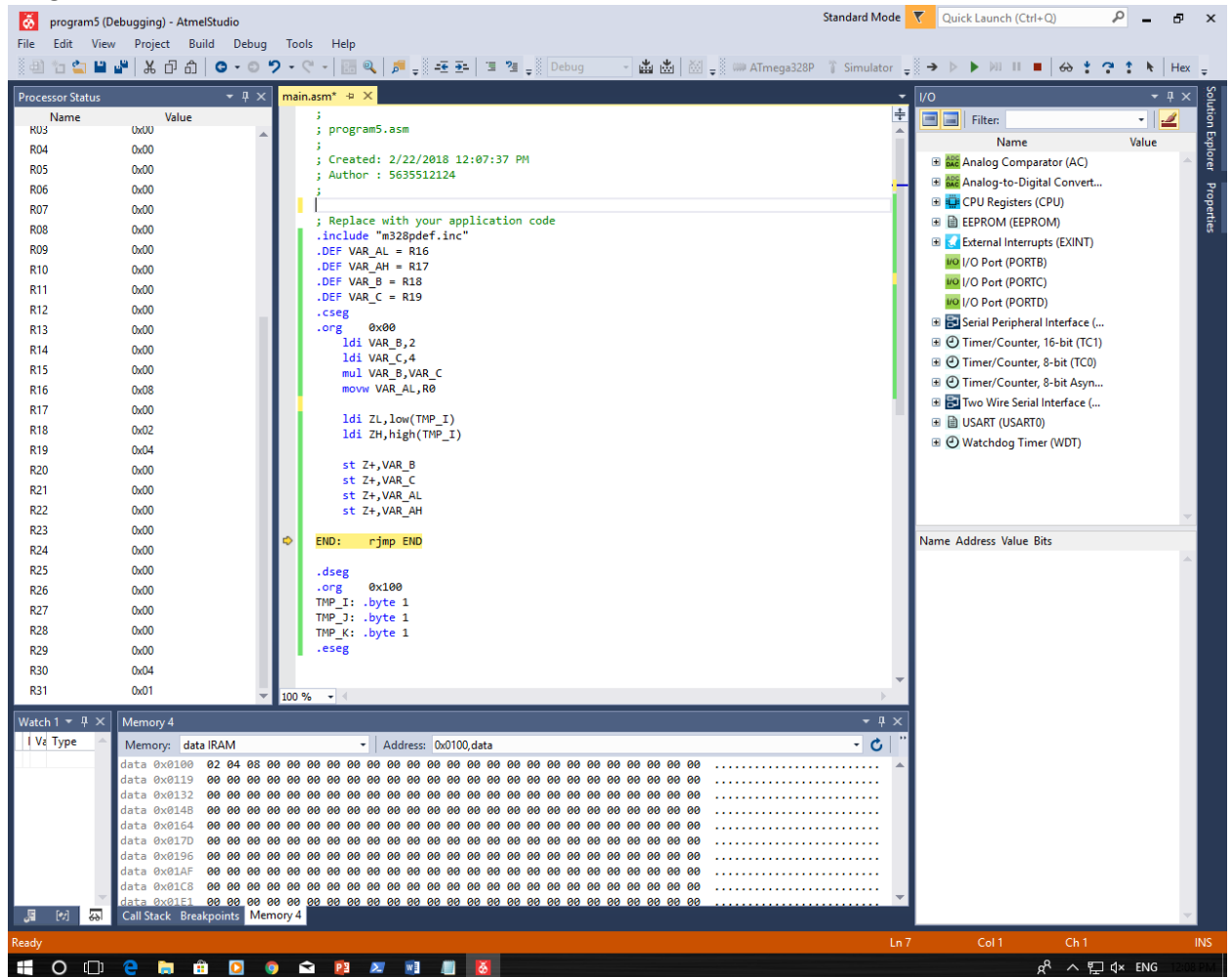
```

The Processor Status window on the left shows the values of registers R03 through R31. The Memory window at the bottom shows the memory layout, including data IRAM and data ORAM. The I/O window on the right shows the I/O Port (PORTB) and other hardware components.

- Program 3



- Program 5



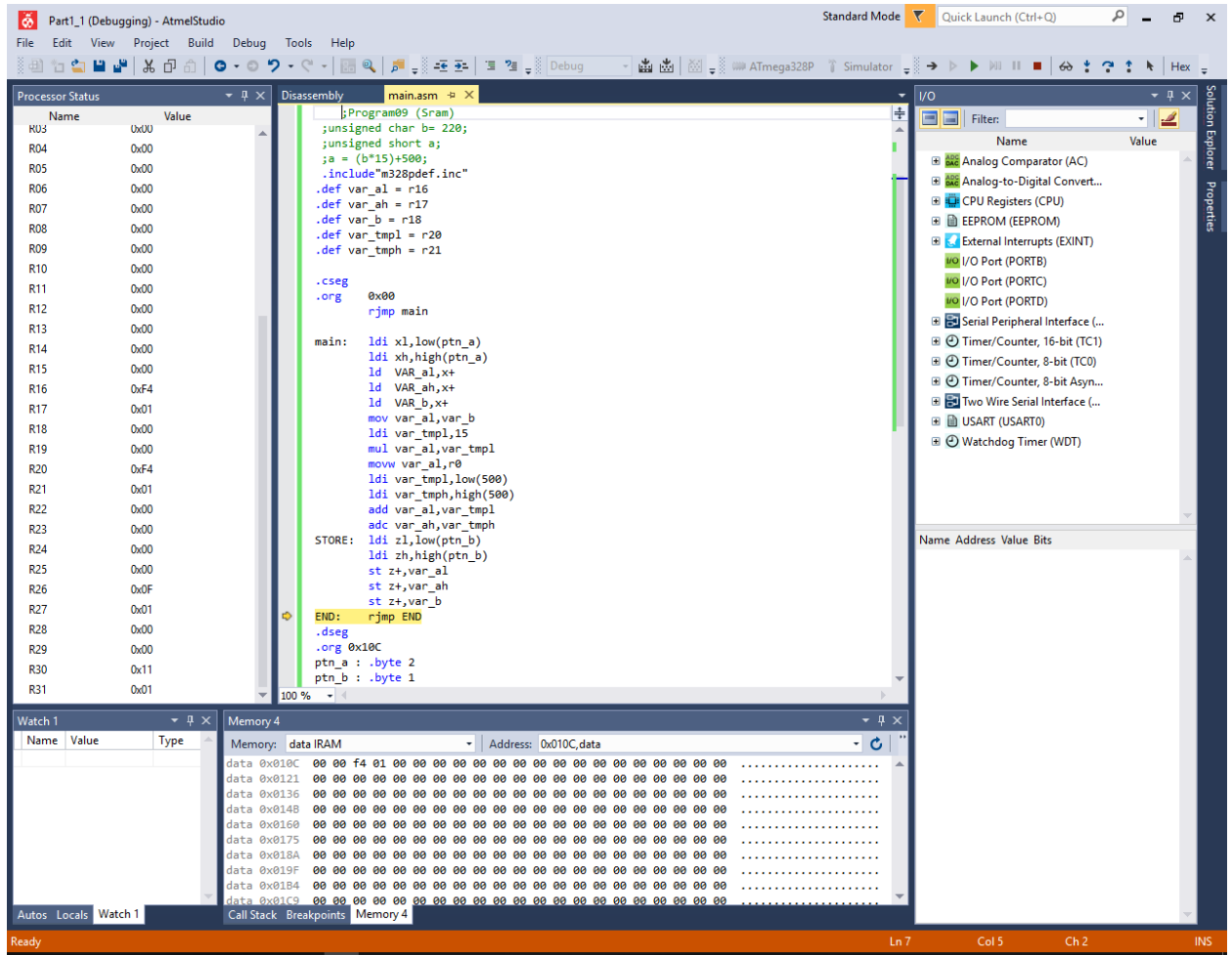
- Program 9 (Flash)

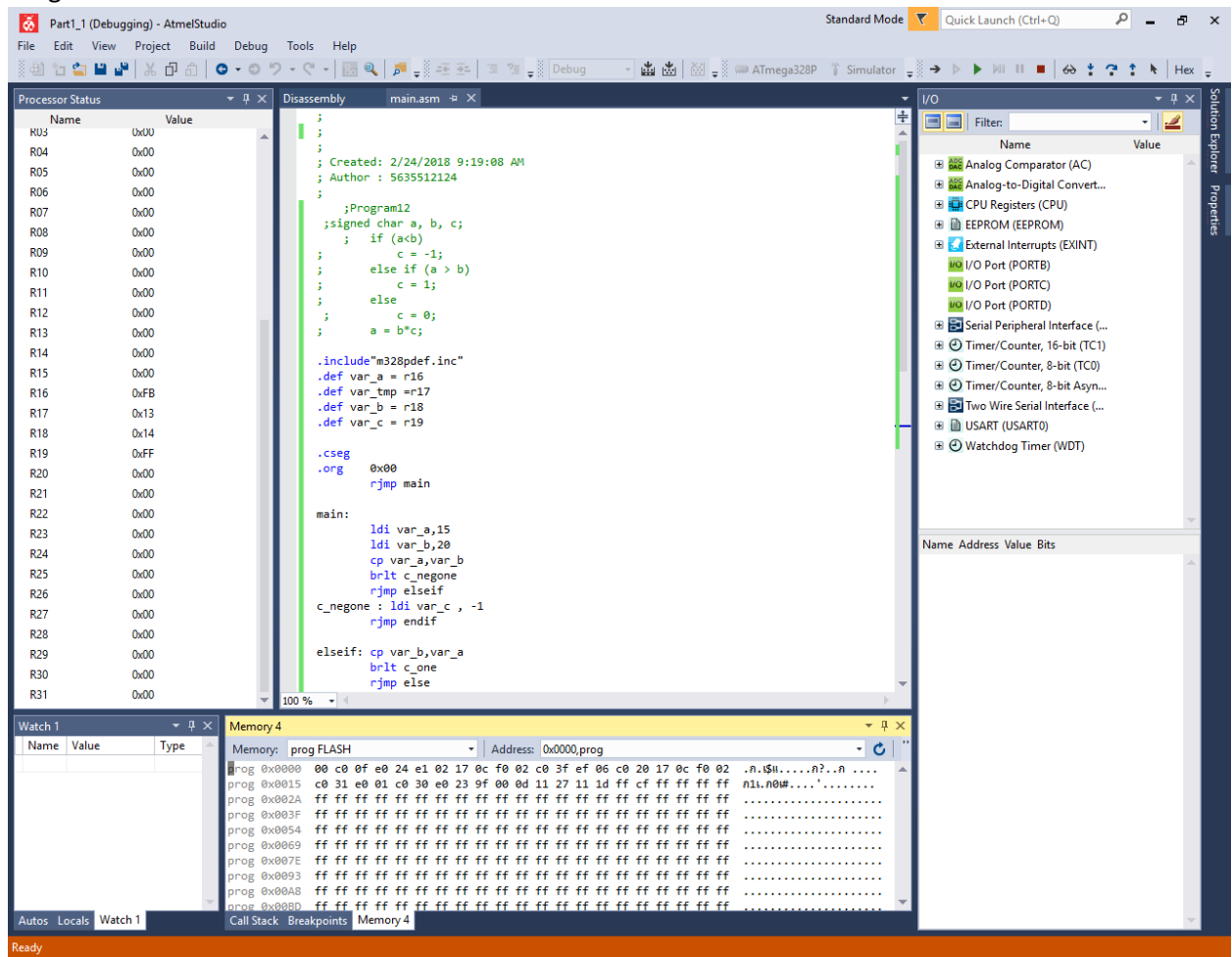
The screenshot displays the Atmel Studio IDE in Standard Mode, showing the assembly code for Program 9 (Flash). The main window displays the assembly code for the file `main.asm`. The code includes comments about the creation date and author, followed by a program header and a main function. The main function performs a calculation: `mov var_al, var_b`, `ldi var_tmpl, 15`, `mul var_al, var_tmpl`, `movw var_al, r0`, `ldi var_tmpl, low(500)`, `ldi var_tmph, high(500)`, `add var_al, var_tmpl`, and `adc var_ah, var_tmph`. The code ends with `END: rjmp END`.

The Processor Status window on the left shows the status of registers R03 through R31, all with a value of 0x00. The Solution Explorer on the right lists various hardware components, including the Analog Comparator (AC), Analog-to-Digital Converter (ADC), CPU Registers (CPU), EEPROM (EEPROM), External Interrupts (EXINT), I/O Port (PORTB), I/O Port (PORTC), I/O Port (PORTD), Serial Peripheral Interface (SPI), Timer/Counter, 16-bit (TC1), Timer/Counter, 8-bit (TC0), Timer/Counter, 8-bit Asynchronous (TCC), Two Wire Serial Interface (TWI), USART (USART0), and Watchdog Timer (WDT).

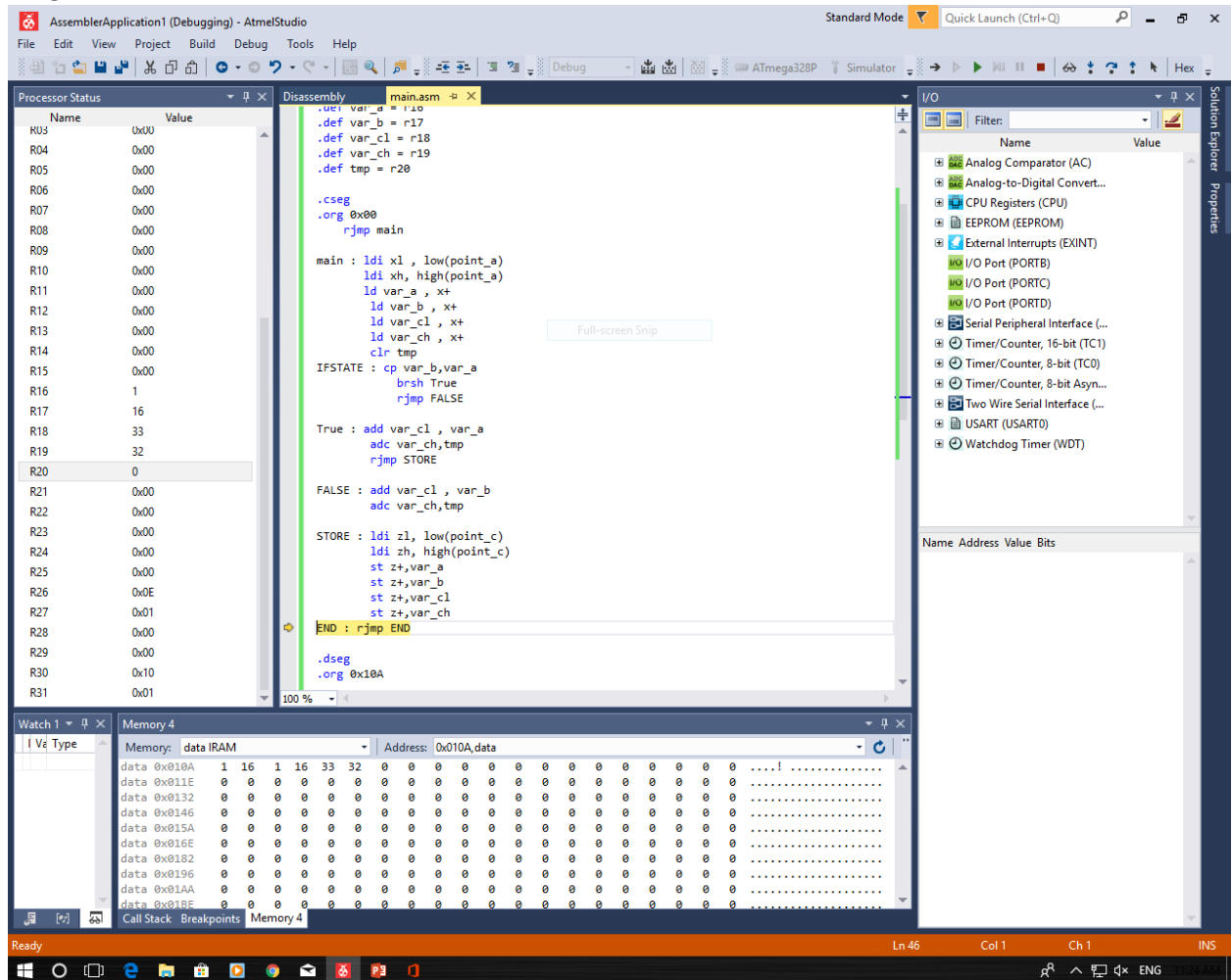
The Watch/Memory window at the bottom shows the memory address 0x010C, which is the address of the `data` variable. The memory content is shown as a series of 0x00 values, indicating that the variable has not been initialized.

- Program 9 (Sram)

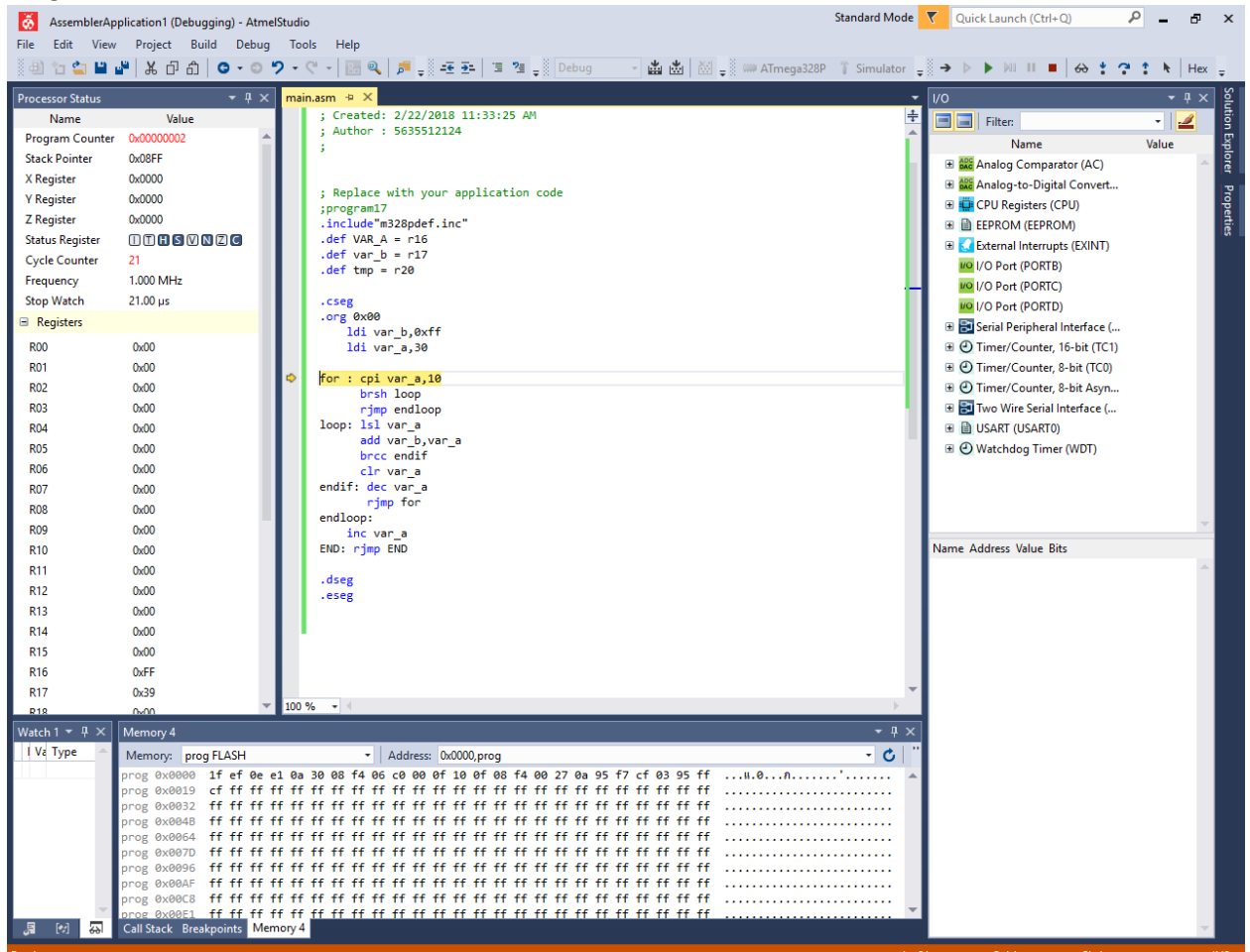




- Program13



- Program 17



- Program 18

- Program 19

The screenshot displays the Atmel Studio IDE interface for Program 19. The main window shows the assembly code in `main.asm`, which includes comments about the file's creation and author, followed by assembly directives and instructions for an ATmega328P microcontroller. The code defines variables `var_a`, `var_b`, `var_I`, and `temp`, and implements a `WHILE` loop and a `loop` for multiplying `var_b` by `temp`.

The **Processor Status** window on the left shows the values of registers R03 through R31, most of which are 0x00, with R16 at 0x0F, R17 at 0x1B, and R18 at 0x03.

The **Memory** window at the bottom shows the program flash memory layout, starting at address 0x0000. The memory contains the assembled code, with the first few lines showing the instruction `ldi var_a,15` at address 0x0000.

The **I/O** window on the right lists various hardware modules available for the ATmega328P, including the Analog Comparator (AC), CPU Registers (CPU), EEPROM (EEPROM), External Interrupts (EXINT), I/O Ports (PORTB, PORTC, PORTD), Serial Peripheral Interface (SPI), Timer/Counter (TC1, TC0), Two Wire Serial Interface (I2C), USART (USART0), and Watchdog Timer (WDT).