

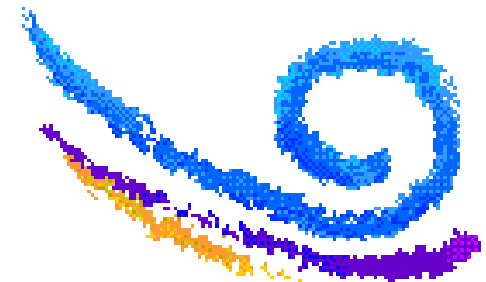
# **New Tricks for Old Dogs**

**Assembler Language - Big Picture**

# The Assembler - some changes

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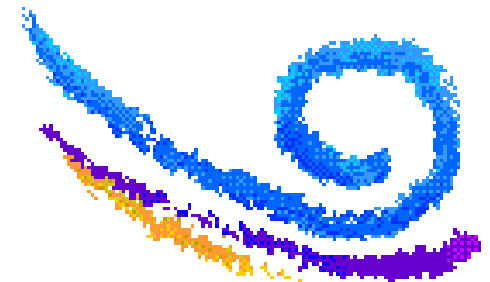
- ▶ Support for long data item names (up to 63 characters)
- ▶ Support for mixed case code
- ▶ Support for new data types
  - 64-bit integers
  - 64-bit addresses
  - Unicode character strings
  - IEEE floating point
- ▶ New Extended mnemonics (Jump)
- ▶ Labeled USINGs, dependent USINGs



# The Hardware - changes prior to z/Architecture

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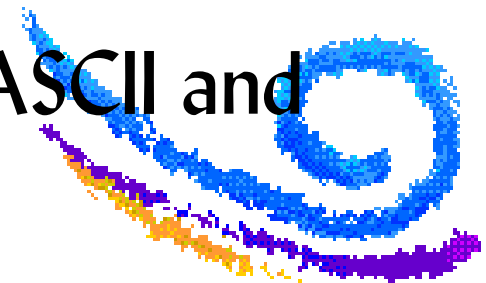
- ▶ Multiply Single (MSR, MS)
- ▶ Halfword Immediate (AHI, CHI, LHI, MHI, TMH, TML)
- ▶ Logical String Assist (CLST, CUSE, MVST, SRST)
- ▶ Extended long instructions (CLCLE, MVCLE, TRE)
- ▶ Relative Branching (BRAS, BRC, BRCT, BRXH, BRXLE)
- ▶ Unicode instructions (CUUTF, CUTFU)
- ▶ New floating point instructions (numerous)



# z/Architecture Instruction Additions

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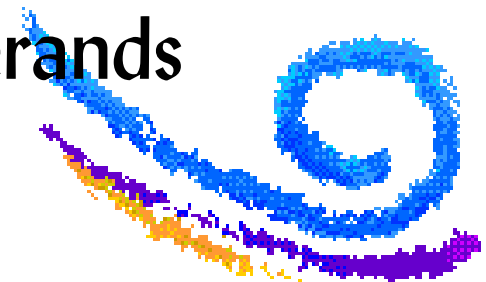
- ▶ Long branches - relative to current instruction
- ▶ Addressing mode switching and testing
- ▶ Specialized - EPSW
- ▶ Store and load instructions - all parts of 64-bit registers, from and to appropriate size memory locations
- ▶ ASCII support - pack and unpack
- ▶ Unicode support - pack and unpack
- ▶ Packed decimal instructions - TP plus the ASCII and Unicode pack and unpack



# More z/Architecture Additions

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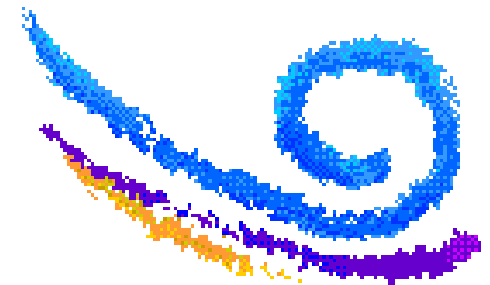
- ▶ Binary arithmetic - combinations of 32-bit and 64-bit operands
- ▶ Logical binary - loading, storing, comparing, and logical arithmetic operations on 32-bit and 64-bit operands
- ▶ Bit-oriented instructions - ORs, ANDs and XORs of various size operands, new Test Under Mask variants
- ▶ Shift instructions - 64-bit operands
- ▶ Rotate instructions - 32-bit and 64-bit operands



# More z/Architecture Instructions

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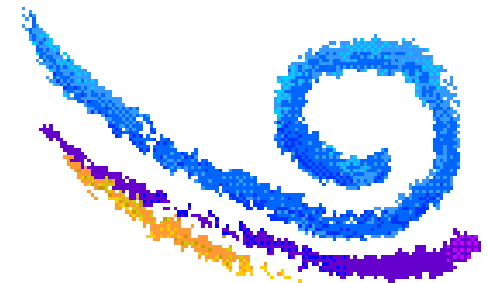
- ▶ Translate instructions - one or two byte inputs, one or two byte outputs
- ▶ Load / Store Reversed - to deal with endian issues
- ▶ Floating point <---> 64-bit integer conversions
- ▶ Classic\_floating\_point <---> IEEE\_floating\_point conversions



# z/990 Instructions

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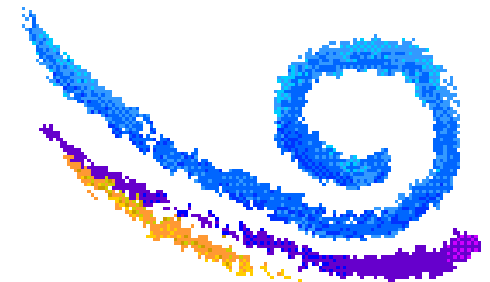
- ▶ The advent of the z/990 machine introduced additional instructions (which are retrofitted to earlier z/Architecture machines)
  - Long displacement uses 20-bit displacements instead of the traditional 12 bits
  - Cryptographic instructions



# z9 Instructions

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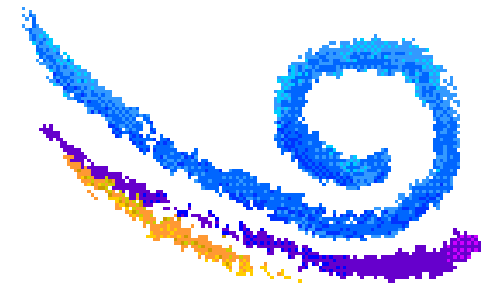
- ▶ The z9 series added a few instructions, such as
  - MVCOS - Move Characters with Optional Specifications
  - ECTG - Extract CPU Time
  - CSST - Compare and Swap and Store
  - Decimal Floating Point instructions



# z10 Instructions

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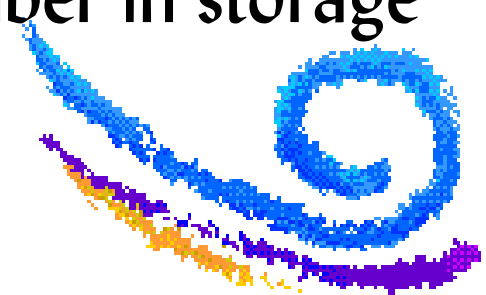
- ▶ The z10 series added many new instructions, such as
  - Data locations referenced using long displacements
  - Data locations referenced using relative displacements
  - Compare and branch in a single instruction
  - Compare and trap ("blow up")



# z10 Instructions, 2

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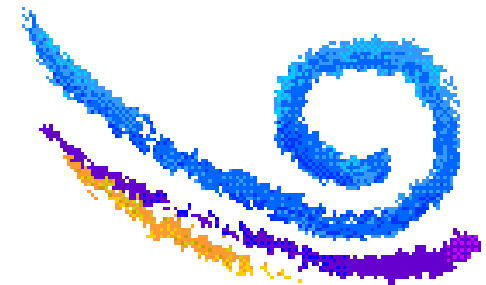
- ▶ Additional z10 series new instructions
  - Additional compares with long relative displacements
  - Additional halfword immediate instructions
  - EXRL - EXecute Relative Long
  - Add immediate byte to 32-bit or 64-bit number in storage



# z10 Instructions, 3

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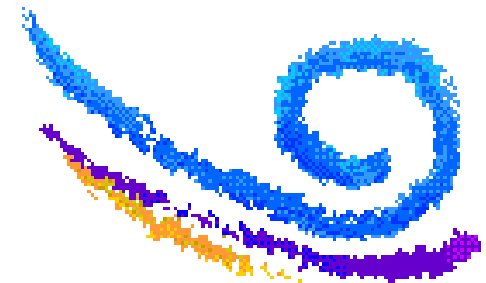
- ▶ Additional z10 series new instructions
  - New binary multiply instructions
  - Instructions to rotate bits in a register
  - Move immediate data to storage locations
  - New Translate and Test instructions



# The z196

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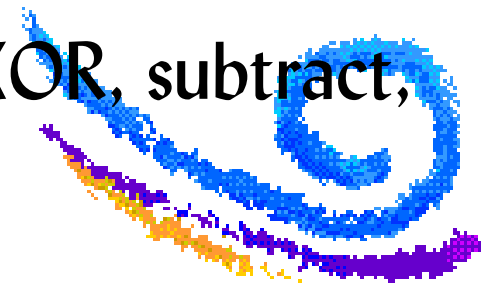
- ▶ A new mainframe model, the z196, was announced in July, 2010, with availability in September, 2010:
  - About 100 new instructions
  - Increased memory size
  - Increased number of CPs in a sysplex
  - Additional hardware features



# z196 Instructions

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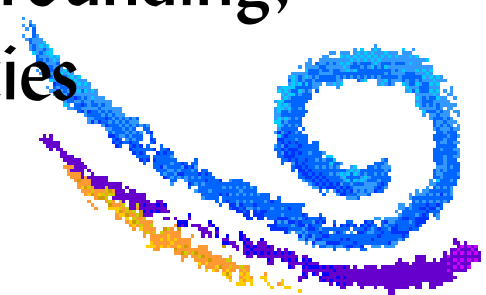
- ▶ As an overview, the new instructions fall into these categories:
  - High Word Facility: use left hand word in registers as if they were separate registers
  - Interlocked Access Facility: access and update storage value in a single cycle (reduce need for locking instructions)
  - Distinct Operands Facility: add, AND, OR, XOR, subtract, and shift with result in separate register



# z196 Instructions, 2

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- ▶ Additional categories for new instructions:
  - Load/Store on Condition Facility: load or store a value to / from a register based on the current condition code
  - Population Count Facility: return the number of '1' values for a byte in a register
  - Floating Point Extensions Facility: enhanced rounding, conversion, and exception handling capabilities





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