1. simd and RUSTFLAGS

simd（单指令流多数据流）支持与硬件紧密关联，在rust-lang/rust/src/librustc\_target中对不同的硬件平台和操作系统进行了相应的支持。

为了让rust编译器根据不同的平台使用特定的指令集，可通过环境变量RUSTFLAGS来让编译器生成相应平台的相应指令集代码。

通过设置RUSTFLAGS="-C target-cpu=xxx"或RUSTFLAGS="-C target-features=+xxx"来分别指定CPU和指令集。

2. 查看当前Rust所支持simd

2.1 查看Rust所支持的平台

rustc --print target-list

1

与rust-lang/rust/src/librustc\_target/spec中的\*.rs文件对应。

aarch64-fuchsia

aarch64-linux-android

aarch64-pc-windows-msvc

aarch64-unknown-cloudabi

aarch64-unknown-freebsd

aarch64-unknown-hermit

aarch64-unknown-linux-gnu

aarch64-unknown-linux-musl

aarch64-unknown-netbsd

aarch64-unknown-none

aarch64-unknown-openbsd

arm-linux-androideabi

arm-unknown-linux-gnueabi

arm-unknown-linux-gnueabihf

arm-unknown-linux-musleabi

arm-unknown-linux-musleabihf

armebv7r-none-eabi

armebv7r-none-eabihf

armv4t-unknown-linux-gnueabi

armv5te-unknown-linux-gnueabi

armv5te-unknown-linux-musleabi

armv6-unknown-freebsd

armv6-unknown-netbsd-eabihf

armv7-linux-androideabi

armv7-unknown-cloudabi-eabihf

armv7-unknown-freebsd

armv7-unknown-linux-gnueabihf

armv7-unknown-linux-musleabihf

armv7-unknown-netbsd-eabihf

armv7r-none-eabi

armv7r-none-eabihf

asmjs-unknown-emscripten

i586-pc-windows-msvc

i586-unknown-linux-gnu

i586-unknown-linux-musl

i686-apple-darwin

i686-linux-android

i686-pc-windows-gnu

i686-pc-windows-msvc

i686-unknown-cloudabi

i686-unknown-dragonfly

i686-unknown-freebsd

i686-unknown-haiku

i686-unknown-linux-gnu

i686-unknown-linux-musl

i686-unknown-netbsd

i686-unknown-openbsd

mips-unknown-linux-gnu

mips-unknown-linux-musl

mips-unknown-linux-uclibc

mips64-unknown-linux-gnuabi64

mips64el-unknown-linux-gnuabi64

mipsel-unknown-linux-gnu

mipsel-unknown-linux-musl

mipsel-unknown-linux-uclibc

mipsisa32r6-unknown-linux-gnu

mipsisa32r6el-unknown-linux-gnu

mipsisa64r6-unknown-linux-gnuabi64

mipsisa64r6el-unknown-linux-gnuabi64

msp430-none-elf

nvptx64-nvidia-cuda

powerpc-unknown-linux-gnu

powerpc-unknown-linux-gnuspe

powerpc-unknown-linux-musl

powerpc-unknown-netbsd

powerpc64-unknown-freebsd

powerpc64-unknown-linux-gnu

powerpc64-unknown-linux-musl

powerpc64le-unknown-linux-gnu

powerpc64le-unknown-linux-musl

riscv32imac-unknown-none-elf

riscv32imc-unknown-none-elf

riscv64gc-unknown-none-elf

riscv64imac-unknown-none-elf

s390x-unknown-linux-gnu

sparc-unknown-linux-gnu

sparc64-unknown-linux-gnu

sparc64-unknown-netbsd

sparcv9-sun-solaris

thumbv6m-none-eabi

thumbv7a-pc-windows-msvc

thumbv7em-none-eabi

thumbv7em-none-eabihf

thumbv7m-none-eabi

thumbv7neon-linux-androideabi

thumbv7neon-unknown-linux-gnueabihf

thumbv8m.base-none-eabi

thumbv8m.main-none-eabi

thumbv8m.main-none-eabihf

wasm32-experimental-emscripten

wasm32-unknown-emscripten

wasm32-unknown-unknown

wasm32-unknown-wasi

x86\_64-apple-darwin

x86\_64-fortanix-unknown-sgx

x86\_64-fuchsia

x86\_64-linux-android

x86\_64-pc-windows-gnu

x86\_64-pc-windows-msvc

x86\_64-rumprun-netbsd

x86\_64-sun-solaris

x86\_64-unknown-bitrig

x86\_64-unknown-cloudabi

x86\_64-unknown-dragonfly

x86\_64-unknown-freebsd

x86\_64-unknown-haiku

x86\_64-unknown-hermit

x86\_64-unknown-l4re-uclibc

x86\_64-unknown-linux-gnu

x86\_64-unknown-linux-gnux32

x86\_64-unknown-linux-musl

x86\_64-unknown-netbsd

x86\_64-unknown-openbsd

x86\_64-unknown-redox

x86\_64-unknown-uefi

2.2 查看Rust所支持平台的所支持的features（指令集）

# uname -a //查看当前系统平台

Linux zyd-VirtualBox 4.15.0-58-generic #64~16.04.1-Ubuntu SMP Wed Aug 7 14:10:35 UTC 2019 x86\_64 x86\_64 x86\_64 GNU/Linux

# rustc --target=x86\_64-unknown-linux-gnu --print target-features

Available features for this target:

16bit-mode - 16-bit mode (i8086).

32bit-mode - 32-bit mode (80386).

3dnow - Enable 3DNow! instructions.

3dnowa - Enable 3DNow! Athlon instructions.

64bit - Support 64-bit instructions.

64bit-mode - 64-bit mode (x86\_64).

adx - Support ADX instructions.

aes - Enable AES instructions.

atom - Intel Atom processors.

avx - Enable AVX instructions.

avx2 - Enable AVX2 instructions.

avx512bitalg - Enable AVX-512 Bit Algorithms.

avx512bw - Enable AVX-512 Byte and Word Instructions.

avx512cd - Enable AVX-512 Conflict Detection Instructions.

avx512dq - Enable AVX-512 Doubleword and Quadword Instructions.

avx512er - Enable AVX-512 Exponential and Reciprocal Instructions.

avx512f - Enable AVX-512 instructions.

avx512ifma - Enable AVX-512 Integer Fused Multiple-Add.

avx512pf - Enable AVX-512 PreFetch Instructions.

avx512vbmi - Enable AVX-512 Vector Byte Manipulation Instructions.

avx512vbmi2 - Enable AVX-512 further Vector Byte Manipulation Instructions.

avx512vl - Enable AVX-512 Vector Length eXtensions.

avx512vnni - Enable AVX-512 Vector Neural Network Instructions.

avx512vpopcntdq - Enable AVX-512 Population Count Instructions.

bmi - Support BMI instructions.

bmi2 - Support BMI2 instructions.

cldemote - Enable Cache Demote.

clflushopt - Flush A Cache Line Optimized.

clwb - Cache Line Write Back.

clzero - Enable Cache Line Zero.

cmov - Enable conditional move instructions.

cx16 - 64-bit with cmpxchg16b.

ermsb - REP MOVS/STOS are fast.

f16c - Support 16-bit floating point conversion instructions.

false-deps-lzcnt-tzcnt - LZCNT/TZCNT have a false dependency on destregister.

false-deps-popcnt - POPCNT has a false dependency on dest register.

fast-11bytenop - Target can quickly decode up to 11 byte NOPs.

fast-15bytenop - Target can quickly decode up to 15 byte NOPs.

fast-bextr - Indicates that the BEXTR instruction is implemented as a single uop with good throughput..

fast-gather - Indicates if gather is reasonably fast..

fast-hops - Prefer horizontal vector math instructions (haddp, phsub, etc.) over normal vector instructions with shuffles.

fast-lzcnt - LZCNT instructions are as fast as most simple integer ops.

fast-partial-ymm-or-zmm-write - Partial writes to YMM/ZMM registers are fast.

fast-scalar-fsqrt - Scalar SQRT is fast (disable Newton-Raphson).

fast-shld-rotate - SHLD can be used as a faster rotate.

fast-variable-shuffle - Shuffles with variable masks are fast.

fast-vector-fsqrt - Vector SQRT is fast (disable Newton-Raphson).

fma - Enable three-operand fused multiple-add.

fma4 - Enable four-operand fused multiple-add.

fsgsbase - Support FS/GS Base instructions.

fxsr - Support fxsave/fxrestore instructions.

gfni - Enable Galois Field Arithmetic Instructions.

glm - Intel Goldmont processors.

glp - Intel Goldmont Plus processors.

idivl-to-divb - Use 8-bit divide for positive values less than 256.

idivq-to-divl - Use 32-bit divide for positive values less than 2^32.

invpcid - Invalidate Process-Context Identifier.

lea-sp - Use LEA for adjusting the stack pointer.

lea-uses-ag - LEA instruction needs inputs at AG stage.

lwp - Enable LWP instructions.

lzcnt - Support LZCNT instruction.

macrofusion - Various instructions can be fused with conditional branches.

merge-to-threeway-branch - Merge branches to a three-way conditional branch.

mmx - Enable MMX instructions.

movbe - Support MOVBE instruction.

movdir64b - Support movdir64b instruction.

movdiri - Support movdiri instruction.

mpx - Support MPX instructions.

mwaitx - Enable MONITORX/MWAITX timer functionality.

nopl - Enable NOPL instruction.

pad-short-functions - Pad short functions.

pclmul - Enable packed carry-less multiplication instructions.

pconfig - platform configuration instruction.

pku - Enable protection keys.

popcnt - Support POPCNT instruction.

prefer-256-bit - Prefer 256-bit AVX instructions.

prefetchwt1 - Prefetch with Intent to Write and T1 Hint.

prfchw - Support PRFCHW instructions.

ptwrite - Support ptwrite instruction.

rdpid - Support RDPID instructions.

rdrnd - Support RDRAND instruction.

rdseed - Support RDSEED instruction.

retpoline - Remove speculation of indirect branches from the generated code, either by avoiding them entirely or lowering them with a speculation blocking construct..

retpoline-external-thunk - When lowering an indirect call or branch using a `retpoline`, rely on the specified user provided thunk rather than emitting one ourselves. Only has effect when combined with some other retpoline feature..

retpoline-indirect-branches - Remove speculation of indirect branches from the generated code..

retpoline-indirect-calls - Remove speculation of indirect calls from the generated code..

rtm - Support RTM instructions.

sahf - Support LAHF and SAHF instructions.

sgx - Enable Software Guard Extensions.

sha - Enable SHA instructions.

shstk - Support CET Shadow-Stack instructions.

slm - Intel Silvermont processors.

slow-3ops-lea - LEA instruction with 3 ops or certain registers is slow.

slow-incdec - INC and DEC instructions are slower than ADD and SUB.

slow-lea - LEA instruction with certain arguments is slow.

slow-pmaddwd - PMADDWD is slower than PMULLD.

slow-pmulld - PMULLD instruction is slow.

slow-shld - SHLD instruction is slow.

slow-two-mem-ops - Two memory operand instructions are slow.

slow-unaligned-mem-16 - Slow unaligned 16-byte memory access.

slow-unaligned-mem-32 - Slow unaligned 32-byte memory access.

soft-float - Use software floating point features..

sse - Enable SSE instructions.

sse-unaligned-mem - Allow unaligned memory operands with SSE instructions.

sse2 - Enable SSE2 instructions.

sse3 - Enable SSE3 instructions.

sse4.1 - Enable SSE 4.1 instructions.

sse4.2 - Enable SSE 4.2 instructions.

sse4a - Support SSE 4a instructions.

ssse3 - Enable SSSE3 instructions.

tbm - Enable TBM instructions.

tremont - Intel Tremont processors.

vaes - Promote selected AES instructions to AVX512/AVX registers.

vpclmulqdq - Enable vpclmulqdq instructions.

waitpkg - Wait and pause enhancements.

wbnoinvd - Write Back No Invalidate.

x87 - Enable X87 float instructions.

xop - Enable XOP instructions.

xsave - Support xsave instructions.

xsavec - Support xsavec instructions.

xsaveopt - Support xsaveopt instructions.

xsaves - Support xsaves instructions.

Use +feature to enable a feature, or -feature to disable it.

For example, rustc -C -target-cpu=mycpu -C target-feature=+feature1,-feature2

不同的CPU平台支持不同的指令集，可参见CPU指令集，Rust对指令集的选择通过-C target-features=+avx2来enable avx2指令集。注意，尽管所有支持AVX2的CPU都支持FMA，但是如果想同时使用AVX2和FMA，需明确enable，如-C target-features=+avx2,+fma。若想启用的指令集间有依赖关系，也需启用所有依赖的指令集。

2.3 查看Rust所支持平台的所支持的CPU

rustc --target=x86\_64-unknown-linux-gnu --print target-cpus

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Available CPUs for this target:

native - Select the CPU of the current host (currently skylake).

amdfam10 - Select the amdfam10 processor.

athlon - Select the athlon processor.

athlon-4 - Select the athlon-4 processor.

athlon-fx - Select the athlon-fx processor.

athlon-mp - Select the athlon-mp processor.

athlon-tbird - Select the athlon-tbird processor.

athlon-xp - Select the athlon-xp processor.

athlon64 - Select the athlon64 processor.

athlon64-sse3 - Select the athlon64-sse3 processor.

atom - Select the atom processor.

barcelona - Select the barcelona processor.

bdver1 - Select the bdver1 processor.

bdver2 - Select the bdver2 processor.

bdver3 - Select the bdver3 processor.

bdver4 - Select the bdver4 processor.

bonnell - Select the bonnell processor.

broadwell - Select the broadwell processor.

btver1 - Select the btver1 processor.

btver2 - Select the btver2 processor.

c3 - Select the c3 processor.

c3-2 - Select the c3-2 processor.

cannonlake - Select the cannonlake processor.

cascadelake - Select the cascadelake processor.

core-avx-i - Select the core-avx-i processor.

core-avx2 - Select the core-avx2 processor.

core2 - Select the core2 processor.

corei7 - Select the corei7 processor.

corei7-avx - Select the corei7-avx processor.

generic - Select the generic processor.

geode - Select the geode processor.

goldmont - Select the goldmont processor.

goldmont-plus - Select the goldmont-plus processor.

haswell - Select the haswell processor.

i386 - Select the i386 processor.

i486 - Select the i486 processor.

i586 - Select the i586 processor.

i686 - Select the i686 processor.

icelake-client - Select the icelake-client processor.

icelake-server - Select the icelake-server processor.

ivybridge - Select the ivybridge processor.

k6 - Select the k6 processor.

k6-2 - Select the k6-2 processor.

k6-3 - Select the k6-3 processor.

k8 - Select the k8 processor.

k8-sse3 - Select the k8-sse3 processor.

knl - Select the knl processor.

knm - Select the knm processor.

lakemont - Select the lakemont processor.

nehalem - Select the nehalem processor.

nocona - Select the nocona processor.

opteron - Select the opteron processor.

opteron-sse3 - Select the opteron-sse3 processor.

penryn - Select the penryn processor.

pentium - Select the pentium processor.

pentium-m - Select the pentium-m processor.

pentium-mmx - Select the pentium-mmx processor.

pentium2 - Select the pentium2 processor.

pentium3 - Select the pentium3 processor.

pentium3m - Select the pentium3m processor.

pentium4 - Select the pentium4 processor.

pentium4m - Select the pentium4m processor.

pentiumpro - Select the pentiumpro processor.

prescott - Select the prescott processor.

sandybridge - Select the sandybridge processor.

silvermont - Select the silvermont processor.

skx - Select the skx processor.

skylake - Select the skylake processor.

skylake-avx512 - Select the skylake-avx512 processor.

slm - Select the slm processor.

tremont - Select the tremont processor.

westmere - Select the westmere processor.

winchip-c6 - Select the winchip-c6 processor.

winchip2 - Select the winchip2 processor.

x86-64 - Select the x86-64 processor.

yonah - Select the yonah processor.

znver1 - Select the znver1 processor.

跨平台编译，需指定相应的CPU，若只是本地运行的话，可以直接export RUSTFLAGS="-C target\_cpu=native"。