

# 方舟、ART和OpenJDK的 RISCV支持

中科院软件所PLCT实验室项目主管 史宁宁

# 目录

- 方舟编译器的RISC-V支持与我们的工作
- Android Runtime的RISC-V支持与我们的工作
- OpenJDK/HotSpot的RISC-V支持与我们的工作

# 目录

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- OpenJDK/HotSpot的RISC-V支持与我们的工作

# 方舟编译器的RISC-V支持

The screenshot shows the Gitee website interface. At the top, there's a navigation bar with the Gitee logo, links for '开源软件', '企业版', '高校版', '博客', '我的', and a search bar. Below the navigation bar, there's a secondary bar with links for '概览', '仓库 7', 'Issues 34', 'Pull Requests', '动态', and '成员 10'. The main content area is titled '热门' (Popular) and displays a grid of repository cards. The 'mapleall' repository is circled in red. It is described as 'MAPLE - Multiple Architecture and Programming Language Environment' and is a C++ project with 34 forks, 65 stars, and 21 pull requests. Other repositories shown include 'MapleFE', 'clang2mpl', 'maple\_engine', 'js2mpl', and 'pacific'. On the right side, there's a '成就' (Achievements) section showing statistics: 7 repositories, 27 PRs, 212 stars, and 59 forks. At the bottom, there's a '仓库语言' (Repository Language) section showing a bar chart for C++ at 47%.

gitee 开源软件 企业版 高校版 博客 我的 8周年 搜开源

概览 仓库 7 Issues 34 Pull Requests 动态 成员 10 退出组织 + 新建仓库

热门

**MapleFE** MapleFE is a unified frontend which is able to translate multiple languages into MapleIR. C++ 23 31 7

**clang2mpl** C++ 5 1 2

**maple\_engine** Maple 编译器和引擎 C++ 35 96 23

**js2mpl** 4 0 0

**mapleall** MAPLE - Multiple Architecture and Programming Language Environment C++ 34 65 21

**pacific** pacific是方舟编译器runtime的一个参考实现。 C 5 14 4

组织介绍

**组织介绍**

方舟编译器孵化器，用于孵化开源方舟编译器相关子项目

成就

7 仓库 27 PR 212 Star 59 Fork

仓库语言

C++ 47%

From:  
<https://gitee.com/openarkcompiler-incubator>

# 方舟编译器的RISC-V支持

## 方舟编译器RISC-V后端上线

◎ 待办的

#I25O23

yi\_jiang

拥有者

创建于 2020-11-17 06:00

编辑

本次发布的主要特性是对RISCV后端的支持。配合之前第三方的新前端，我们可以在RISCV的qemu模拟器和设备上成功运行CPU2017的C程序。主要包括功能相关的基本模块如指令选择，寄存器分配和栈布局以及ABI支持，这基本上是方舟编译器后端移植工作的最小集。

欢迎大家试用并提出宝贵意见



<https://gitee.com/openarkcompiler-incubator/mapleall.git>

其中对指令集的描述方法，即机器模型部分，我们暂时没有把流行的DSL机器模型语言当做第一优先级，原因是我们认为后端移植难度主要在于重构优化，然而这部分的确可以降低一部分移植的门槛，所以我们很希望下一步跟社区合作构建这部分能力。另外下一步我们希望着重针对后端差异化最大的优化框架方面做补强，包括扩展基本块优化，指令流优化以及指令调度等等。作为精简指令集合的典型代表，可以预见到大部分的RISCV相关后端优化都有可能被更多后端重用，所以我们计划基于此构建兼容性更好的优化框架，在新体系结构移植构建工程示范的同时减少后续新体系结构移植的开销。

From: <https://gitee.com/openarkcompiler-incubator/mapleall/issues/I25O23>

# 方舟编译器的RISC-V支持


开源项目 > 程序开发 > 编程语言/脚本语言

 方舟编译器孵化器 / mapleall 








Watch 34 Starred 65 Forked 21

[代码](#) [Issues 2](#) [Pull Requests 0](#) [Wiki](#) [统计](#) [DevOps](#) [服务](#)

dev [mapleall / mapleall / maple\\_be / src / cg / riscv64](#) [新建文件](#) [克隆/下载](#)

 Feng Ye Wrong uses of R9/R12 as temp registers cad2eab 4个月前 177 次提交

← ...

 riscv64_abi.cpp	riscv64 bug 35 provide wrapper for call node return info	5个月前
 riscv64_cg.cpp	mplcg aarch64 riscv64 fix cfg opt to move arch dependent op to arch dir	7个月前
 riscv64_cg_func.cpp	Wrong uses of R9/R12 as temp registers	4个月前
 riscv64_color_ra.cpp	riscv64 fix re-use of spill memory space to separate global/locals.	6个月前
 riscv64_dep_analysis.cpp	Support RISC-V target	7个月前
 riscv64_ebo.cpp	riscv64 bug #22 create new imm for is_vary for converting add to addi	6个月前
 riscv64_emit.cpp	Aarch64: support PIC	5个月前

From: [https://gitee.com/openarkcompiler-incubator/mapleall/tree/dev/mapleall/maple\\_be/src/cg/riscv64](https://gitee.com/openarkcompiler-incubator/mapleall/tree/dev/mapleall/maple_be/src/cg/riscv64)

# 方舟编译器的RISC-V支持

[About RISC-V](#) ▾[Membership](#) ▾[RISC-V Exchange](#) ▾[Technical](#) ▾[News & Events](#) ▾[Community](#) ▾

This page is a collection of available software in the RISC-V ecosystem. This list is curated by the community – which includes you! Add software to the list by filing a pull request on the [GitHub repository](#). If you have any questions about this process, [contact us](#) for help.

Simulators	Object Toolchain	Debugging	C Compilers & Libraries	Bootloaders & Monitors	Hypervisors
OS & Kernels	Non-C Compilers/Runtimes	IDEs & SDKs	Security	Machine Learning & AI	Configuration
Verification Tools	Accelerated Libraries				

OpenArkCompiler (MAPLE)	Upstream	MulanPSL-2.0	Futurewei
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From: <https://riscv.org/exchange/software/#tab-1607480869844-2>

# 方舟编译器的RISC-V支持

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OpenArkCompiler (MAPLE)	Upstream	MulanPSL-2.0	Futurewei
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# PLCT实验室在方舟编译器社区的贡献

## Ubuntu 2004 build the riscv release version

🟢 已完成

#I26LIJ

👤 shining

创建于 2020-11-23 16:17

✎ 编辑

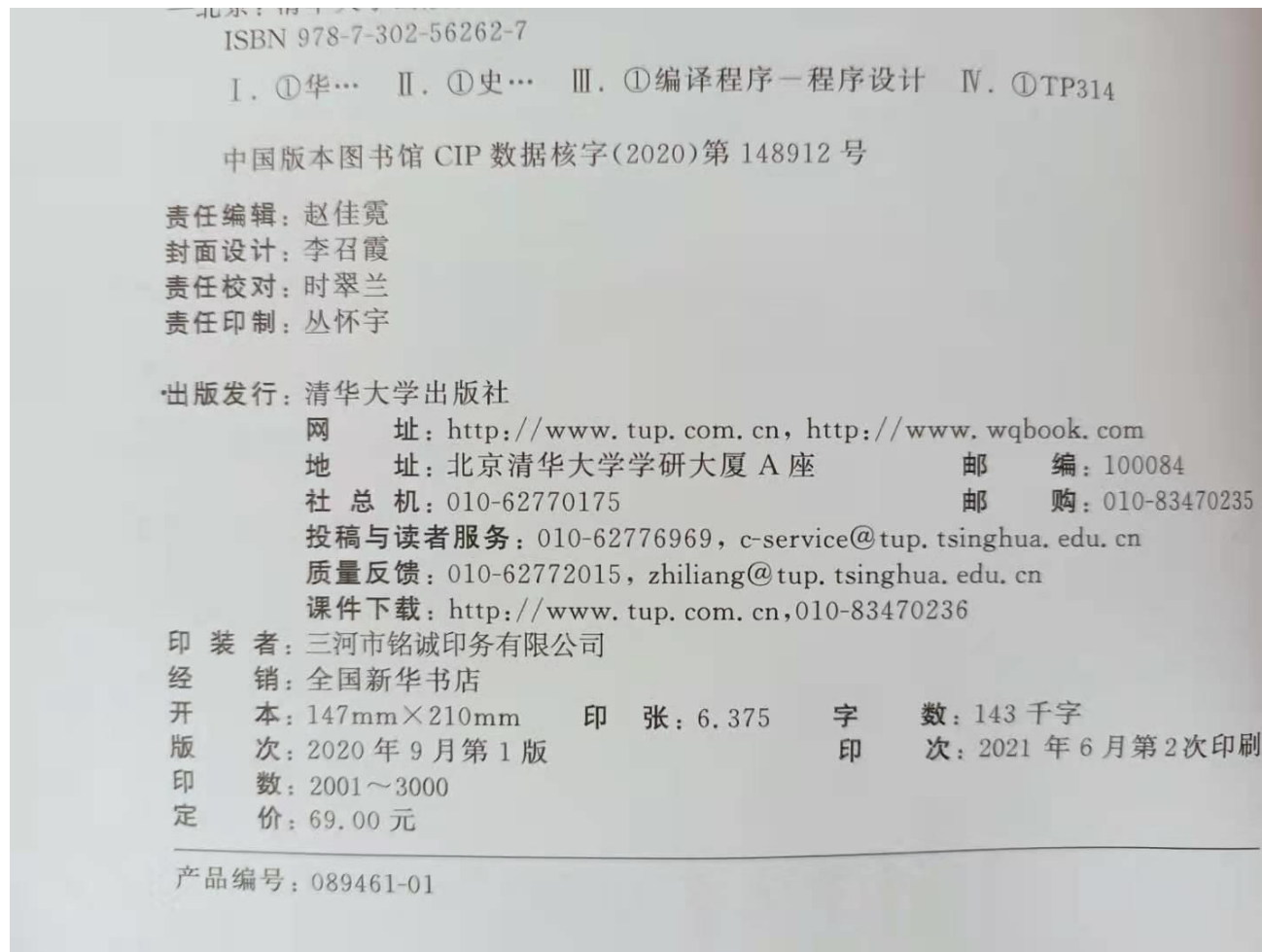
🗑 删除

Run the 'make', get the error messages:

```
mkdir -p /home/shining/mapleall/out/riscv64-clang-release; /home/shining/mapleall/tools/gn/gn gen
/home/shining/mapleall/out/riscv64-clang-release --args=' GN_INSTALL_PREFIX="/home/shining/mapleall"
GN_BUILD_TYPE="RELEASE" USE_CLANG=1 HOST_ARCH=64 JAVA=1 USE_ZRT=0 DEFERRAL_RC="OFF"
STRICT_NAIVE_RC="OFF" RC_TESTING="OFF" USE_MALLOC="" COV_CHECK=0 PLATFORM_SDK_VERSION=27
TARGET="riscv64" X86=1' --export-compile-commands; cd /home/shining/mapleall/out/riscv64-clang-release;
/home/shining/mapleall/tools/ninja_1.9.0/ninja -v irbuild maple mplcg;
Generating compile_commands took 3ms
Done. Made 38 targets from 14 files in 16ms
[1/210] clang++ -I../mapleall/maple_be/include/cg -I../mapleall/maple_be/include/cg/aarch64 -
I../mapleall/maple_be/include/cg/ark -I../mapleall/maple_be/include/cg/riscv64 -I../mapleall/maple_be/include/ad
```

From: <https://gitee.com/openarkcompiler-incubator/mapleall/issues/I26LIJ>

# PLCT实验室在方舟编译器社区的贡献



# PLCT实验室在方舟编译器社区的贡献

专栏  
方舟编译器周报

写文章

## 方舟编译器周报

关注方舟编译器的社区动态与代码提交。

 小乖他爹 · 67 篇内容

收录内容

修改介绍

...

### OpenArkCompiler Weekly - #67 Jun 20th 2021

OpenArkCompiler Weekly - #67 Jun 20th 2021 **社区动态:** 本周社区风平浪静。 **主库 Commits:** 1、Additional Neon intrinsics as requested. [gitee.com/openarkcompil...](https://gitee.com/openarkcompiler/commit/1234567890) 2、identify postIncr/decre v... [阅读全文](#) ▾

赞同 4

添加评论

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### OpenArkCompiler Weekly - #66 Jun 13th 2021

OpenArkCompiler Weekly - #66 Jun 13th 2021 **社区动态:** 本周社区风平浪静。 **主库 Commits:** 1、add spec tools [gitee.com/openarkcompil...](https://gitee.com/openarkcompiler/commit/1234567890) 2、[alias] set nextLev NADS for escape ptr [gitee.com/open...](https://gitee.com/openarkcompiler/commit/1234567890) [阅读全文](#) ▾

赞同 5

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...

### OpenArkCompiler Weekly - #65 Jun 6th 2021

OpenArkCompiler Weekly - #65 Jun 6th 2021 **社区动态:** 本周社区风平浪静。 **主库 Commits:**

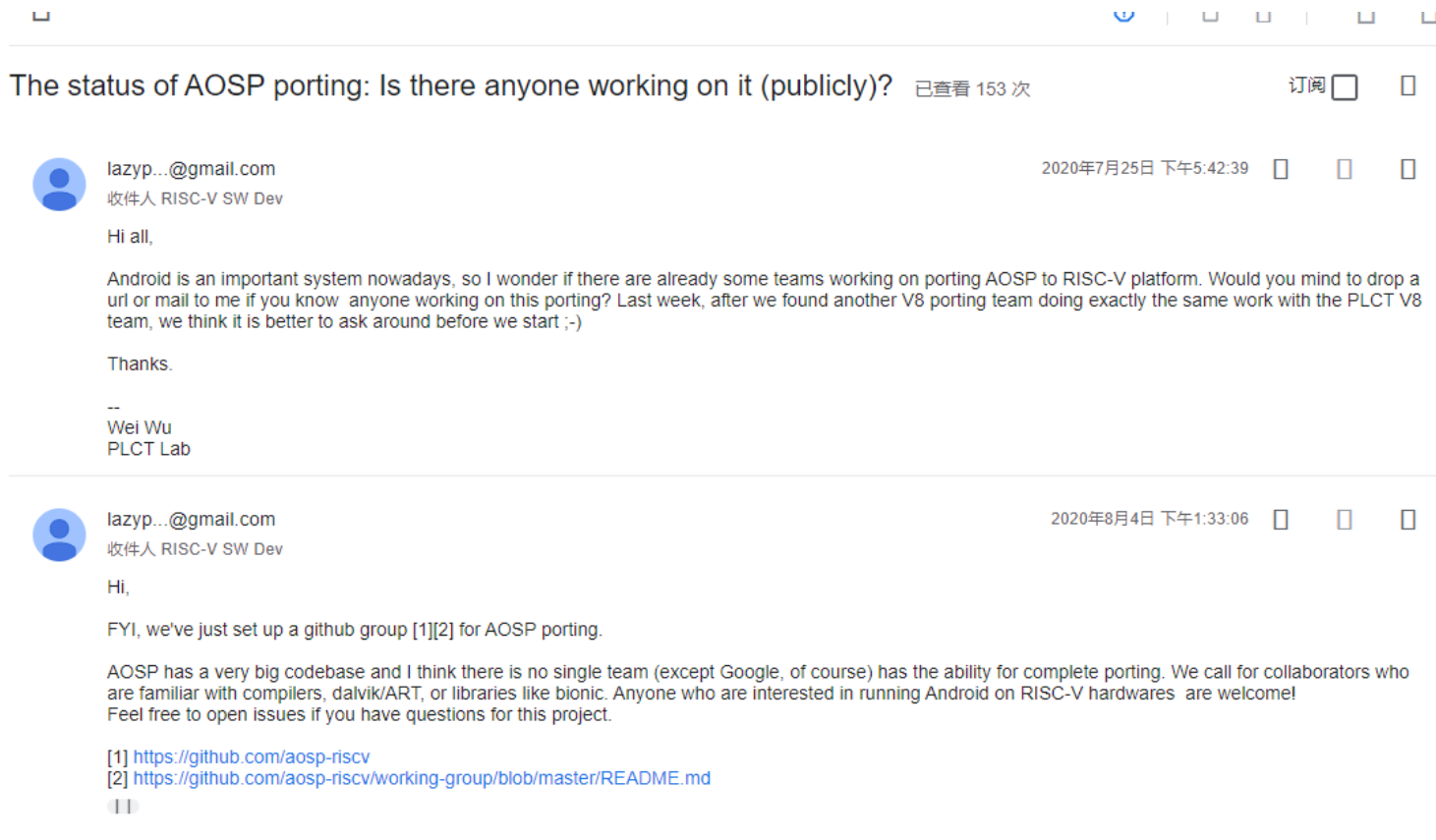
From :  
[https://www.zhihu.com/column/c\\_1268247974020747264](https://www.zhihu.com/column/c_1268247974020747264)

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- OpenJDK/HotSpot的RISC-V支持与我们的工作

# ART的RISC-V支持——PLCT

- PLCT实验室在2020年7月份就提出要将AOSP移植到RISC-V，并在社区发布了话题。



From :  
<https://groups.google.com/a/groups.riscv.org/g/sw-dev/c/u9iP7A2Wkc8>

# ART的RISC-V支持——PLCT

- PLCT实验室在github逐步开始进行AOSP的移植。

The screenshot shows the GitHub repository page for `aosp-riscv/working-group`. The repository has 18 watchers, 44 stars, and 6 forks. The main content area displays a list of files: `.gitignore` (Initial commit, 11 months ago), `README.md` (status updated 2021/1/15, 5 months ago), and `README_zh.md` (status updated 2021/1/15, 5 months ago). Below the file list, the `README.md` content is visible, featuring the title "AOSP on RISC-V WG" and the text: "This is the meta repo for the AOSP for RISC-V Project. General tasks and issues here. If you are interested in running Android on RISC-V hardware, please join us!". The right sidebar contains sections for "About" (meta repo for AOSP for RISC-V Project), "Releases" (No releases published), and "Packages" (No packages published).

`aosp-riscv` / `working-group` Watch 18 Unstar 44 Fork 6

<> Code Issues 1 Pull requests 1 Actions Projects Wiki Security Insights

master 1 branch 0 tags Go to file Add file Code

unicornx Merge pull request #19 from unicornx/aosp-update c287a40 on 15 Jan 37 commits

<code>.gitignore</code>	Initial commit	11 months ago
<code>README.md</code>	status updated 2021/1/15	5 months ago
<code>README_zh.md</code>	status updated 2021/1/15	5 months ago

☰ README.md ✎

## AOSP on RISC-V WG

This is the meta repo for the AOSP for RISC-V Project. General tasks and issues here.

If you are interested in running Android on RISC-V hardware, please join us!

**About**  
meta repo for AOSP for RISC-V Project. General tasks and issues here.  
📖 Readme

**Releases**  
No releases published  
[Create a new release](#)

**Packages**  
No packages published  
[Publish your first package](#)

From :  
<https://github.com/aosp-riscv/working-group>

# ART的RISC-V支持——PLCT

- PLCT实验室在AOSP的移植过程中，公开分享多篇技术文章和讲解视频，有些内容也被媒体进行宣传。

## Articles

- [Version Management for AOSP Platform, Wang Chen - PLCT lab, 20200911 \(Chinese Version\)](#)
- [Version Management for AOSP Kernel, Wang Chen - PLCT lab, 20200915 \(Chinese Version\)](#)
- [Running RISC-V 64 Linux on QEMU, Wang Chen - PLCT lab, 20200923 \(Chinese Version\)](#)
- [Compile Android Kernel for RISC-V, Wang Chen - PLCT lab, 20200929 \(Chinese Version\)](#)
- [Make a LLVM/Clang compiler for RISC-V, Wang Chen - PLCT lab, 20201009 \(Chinese Version\)](#)
- [First "Android minimal system" for RISC-V, Wang Chen - PLCT lab, 20201120 \(Chinese Version\)](#)
- [Create a minimal Android system for RISC-V, Wang Chen - PLCT lab, 20201124](#)
- [RISC-V Gets an Early, Minimal Android 10 Port Courtesy of PLCT Lab, Gareth Halfacree -   
https://abopen.com/, 20201127](#)
- [AOSP-RISCV has a new mirror on Gitee, Wang Chen - PLCT lab, 20201215 \(Chinese Version\)](#)
- [Summary of related knowledge behind AOSP build, Wang Chen - PLCT lab, 20201230](#)
- [Details about AOSP Soong creation process, Wang Chen - PLCT lab, 20210108](#)

From :  
<https://github.com/aosp-riscv/working-group>



# ART的RISC-V支持——PLCT

- PLCT实验室在AOSP的移植过程中，公开分享了多篇技术文章和讲解视频，有些内容也被媒体进行宣传。

- [How difficult when do RISC-V porting for AOSP - Wu Wei - V8 technical symposium - OSDT community - 20200607 \(Chinese Version\)](#)
- [Introduction about Building framwork of AOSP and preliminary trying porting for RISC-V - Wang Chen - 20200805 - PLCT lab \(Chinese Version\)](#)
- [AOSP for RISC-V porting tutorial \(1\) - Introduction about Android Runtime - Wang Chen - 20200814 - PLCT lab \(Chinese Version\)](#)
- [AOSP for RISC-V porting tutorial \(2\) - Starting porting ART - Wang Chen - 20200821 - PLCT lab \(Chinese Version\)](#)

From :  
<https://github.com/aosp-riscv/working-group>



# ART的RISC-V支持——T Head

- 平头哥在2021年1月份开源了移植到RISC-V的Android 10。

T-head-Semi / [aosp-riscv](#) Watch 15 Star 299 Fork 42

<> Code Issues 7 Pull requests Actions Projects Wiki Security Insights

main 1 branch 0 tags Go to file Add file Code

Mao Han Update binary and script for ICE platform 9804e02 on 13 May 9 commits	
patches	Update binary and script for ICE platform last month
resources	Tweak the description to improve readability 5 months ago
script	Update binary and script for ICE platform last month
QUICKSTART.md	Tweak the description to improve readability 5 months ago
README.md	Tweak the description to improve readability 5 months ago
reproduce.sh	Update binary and script for ICE platform last month

README.md

## aosp-riscv

### Overview

T-Head has ported Android 10 on RISC-V architecture. Android's primary purpose is to create an open software platform available for carriers, OEMs, and developers to make their innovative ideas a reality and to introduce a successful, real-world product that improves the mobile experience for users. [Video for Android on XuanTie910](#)

**About**  
AOSP-RISCV  
[Readme](#)

**Releases**  
No releases published

**Packages**  
No packages published

**Languages**

C	55.4%
Makefile	25.8%
Shell	18.8%

From :  
<https://github.com/T-head-Semi/aosp-riscv>

# PLCT实验室在ART方面的工作

- 史宁宁已经完成了基于Android 10的《ART源码详解与实践》一书的初稿。预计年内会正式出版。

# 目录

- 方舟编译器的RISC-V支持与我们的工作
- Android Runtime的RISC-V支持与我们的工作
- OpenJDK/HotSpot的RISC-V支持与我们的工作

# OpenJDK/HotSpot的RISC-V支持

- 华为开源了BishengJDK 11，它基于OpenJDK 11对RV64G进行了实现，目前模版解释器和C1/C2都可以工作。
- 目前，BishengJDK 11正在进行RV64的B扩展和V扩展实现。
- BishengJDK 11目前可以在X86机器上进行交叉编译，并运行在QEMU RISCV64的用户模式下，已经可以通过17000+的jtreg测试用例。
- BishengJDK 11项目库位于gitee，地址为：  
<https://gitee.com/openeuler/bishengjdk-11/tree/risc-v>

# OpenJDK/HotSpot的RISC-V支持

[About RISC-V](#) ▾[Membership](#) ▾[RISC-V Exchange](#) ▾[Technical](#) ▾[News & Events](#) ▾[Community](#) ▾

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OS & Kernels	Non-C Compilers/Runtimes	IDEs & SDKs	Security	Machine Learning & AI	Configuration
Verification Tools	Accelerated Libraries				

BishengJDK/HotSpot (Java Virtual Machine)	Upstream	GPLv2 with Classpath Exception	Yadong Wang
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From: <https://riscv.org/exchange/software/#tab-1607480869844-2>

# PLCT实验室的工作

- PLCT实验室基于BishengJDK 11和OpenJDK11，正在进行RV32G的实现，目前模版解释器已经可以编译成功，正在调试运行中的错误。
- PLCT实验室目前所进行的RV32G工作，工作过程和工作产出都在github公开：<https://github.com/openjdk-riscv/jdk11u>
- 在移植过程中，PLCT实验室产出了十多篇技术文章，这些文章都公开在：<https://github.com/openjdk-riscv/jdk11u/wiki>
- 目前，PLCT实验室有一个三人的团队在进行该项目的移植。

# PLCT实验室的工作

知乎

首发于  
RISC-V学习笔记

写文章

...

## RV32G下lui/auipc和addi结合加载立即数时的补值问题



小乖他爹

中科院软件所 智能软件研究中心 程序语言与编译技术实验室



啊哈、FlyGoat 等 11 人赞同了该文章

### 一、问题描述与解决思路

在32位下，lui/auipc通常用来取一个32位数的高20位，并且是带符号操作，将最高位默认为符号位。那么，取完最高位20位之后，再取低12位的时候，会面临一个补值问题。

假设这个32位内容为正数，lui/auipc取高20位的时候本身没问题，但是后续再对剩余的12位数字进行操作的时候，如果第11位是1，那么这一位会被当成是符号位，就将一个12位的正数变成了一个11位的负数。这种情况之下，lui/auipc和addi的合并操作的计算结果就不对了，就变成了高20位减去了一个低11位负数。正确的结果应该是高20位加上一个正的低12位。焦点就是将本不是符号位的第11位当成了符号位进行处理。

From: <https://zhuanlan.zhihu.com/p/374235855>

# PLCT实验室的工作

知乎

首发于  
RISC-V学习笔记

写文章

## RV32I控制转移指令的偏移量计算问题



小乖他爹

中科院软件所 智能软件研究中心 程序语言与编译技术实验室

百不侵

lazyparser、EnzoLu、Bamboo 等 13 人赞同了该文章

RV32I的控制转移指令可以分为无条件跳转 (unconditional jumps) 和条件分支(conditional branches)。其中, 无条件跳转 (unconditional jumps) 包含JAL和JALR; 条件分支(conditional branches)包含BEQ、BNE、BLT、BLTU、BGE和BGEU。这些控制转移指令会根据指令所带的立即数 (imm) 去计算跳转地址的偏移量, 而这个偏移量的计算在这里有两种方式。

### 第一种偏移量计算方式: 实际偏移量 = 立即数 (imm) \* 2

除了JALR之外的所有RV32I的控制转移指令, 即: JAL、BEQ、BNE、BLT、BLTU、BGE和BGEU, 都采用这种计算方式。在RV32I的规范中可以找到对应的内容。

JAL 规范P20

The jump and link (JAL) instruction uses the J-type format, where the J-immediate encodes a signed offset in multiples of 2 bytes. The offset is sign-extended and added to the address of the jump instruction to form the jump target address. Jumps can therefore target a  $\pm 1$  MiB range.

From: <https://zhuanlan.zhihu.com/p/374235855>



Thanks~

