Table of Contents

0 - Preface

1 - What is Jai?

- 1.1 Some context and history.
- 1.2 What type of language is Jai?

1B - What is Jai - more in depth

- 1.1 What type of language is Jai?
 - 1.1.1 Priorities
 - 1.1.2 Jai tries to be a better C/C++
- 1.2 Comparisons with other languages
- 1.3 Some steps in Jai's history
- 1.4 Specific Jai features
- 1.5 Some wrong ideas in software development
- 1.6 Jai community and communication channels
- 1.7 Jai's popularity

2 - Setting up a Jai development environment

- 2.1 Opening up the Jai compiler toolkit
- 2.2 Setting up the Jai compiler
 - 2.2.1 Copying the compiler to its destination folder
 - 2.2.2 Making the jai command system-wide available
 - 2.2.3 Updating Jai
 - 2.2.4 Prerequisite for Windows
 - 2.2.5 Windows as development platform
 - 2.2.6 Solution for install problem on Linux distros
- 2.3 Editor help for coding Jai
 - 2.3.1 Overview of different editors
 - 2.3.2 Using the Visual Studio Code plugin
 - 2.3.3 How to edit, build and run a Jai program in VS-Code through CodeRunner
- 2.4 The compiler command

2B - Compiler command-line options

3 - Compiling and running your first program

3.1 The main entry point

3.2 Compiling our first program

- 3.2.1 Compile-time
- 3.2.2 Printing output
- 3.2.3 Run-time
- 3.2.4 Running code during compile-time
- 3.2.5 Some remarks
- 3.2.6 Errors
- 3.2.7 Exiting a program

4 - More info about the compiler

- 4.1 General info
- 4.2 Internal byte-code interpreter
- 4.3 Front-end
- 4.4 Back-ends
- 4.5 Linking
- 4.6 Architectures
- 4.7 Debug and release build
- 4.8 Options for giving code at the command-line
- 4.9 The Preload module
- 4.10 Memory management
- 4.11 What happens when Jai starts up?

5 – Constants, variables, types and operations

- 5.1 Data, literals and types
 - 5.1.1 Data and types
 - 5.1.2 The primitive types: bool, int, float, string, void
 - 5.1.3 Using print to display a value
 - 5.1.4 type_of()
- 5.2 Constants
 - 5.2.1 Problem: What if we need the same literal many times in code?
 - 5.2.2 Solution: Constants
- 5.3 Variables
 - 5.3.1 How to declare variables
- 5.4 Errors when defining variables
- 5.5 Multiple assignment
- 5.6 Swapping values
- 5.7 More about printing
 - 5.7.1 Printing more than one value
 - 5.7.2 The write procedures
 - 5.7.3 Printing Unicode

5B - Identifier backslashes

6 - Bool and number types

- 6.1 Boolean values
 - 6.1.1 Equal values and boolean expressions
 - 6.1.2 Boolean operators
 - 6.1.3 The assert statement

6.2 - Number types

- 6.2.1 Comparison operators
- 6.2.2 Arithmetic operators
- 6.2.3 Mixing of different types
- 6.2.4 Casting of values
- 6.2.5 Autocasting with xx
 - 6.2.5.1 Cast of bool to int
 - 6.2.5.2 Cast of int to bool
- 6.2.6 Complex expressions and precedence
- 6.2.7 Bitwise operators
 - 6.2.7.1 Test if a number is even
- 6.2.8 Formatting procs
- 6.2.9 Random numbers

6B - Times and dates

- 6B.1 Getting the current time
- 6B.2 Getting a random number from time

7 - Scope of Variables

- 7.1 Data scope and imperative scope
 - 7.1.1 Global constants and variables
 - 7.1.2 Local variables
- 7.2 Shadowing of variables

8 - Structuring a project's code

- 8.1 Structuring with modules
- 8.2 Loading files with #load
- 8.3 Named imports
- 8.4 Import a file, a dir or a string
- 8.5 Structuring a project
- 8.6 -import_dir
- 8.7 Module parameters
 - 8.7.1 Definition and use
 - 8.7.2 Creating your own module parameters

8B – The #scope directives

- 8B.1 The #scope_file and #scope_export directives
- 8B.2 Scope in a module
- 8B.3 An example of using the #scope directives

9 – More about types

- 9.1 Constants of type Type: Type alias
- 9.2 Variables of type Type
- 9.3 size_of
- 9.4 The Any type
- 9.5 Any and the print procedure
- 9.6 Type comparisons

10 – Working with pointers

- 10.1 What is a pointer?
- 10.2 Pointers to pointers
- 10.3 Dereferencing a null pointer
- 10.4 Dangling pointers
- 10.5 Casting to pointer types
- 10.6 Relative pointers *~snn

11 - Allocating and freeing memory

- 11.1 The defer keyword
- 11.2 Allocating and freeing primitive variables

12 - Basics of structs

- 12.1 Struct declarations
- 12.2 Making struct variables
- 12.3 Nested structs
- 12.4 Struct literals
- 12.5 Making structs on the heap
- 12.6 Recursive structs
 - 12.6.1 Linked List
 - 12.6.2 Double Linked List
 - 12.6.3 Tree
 - 12.6.4 Circular dependencies
- 12.7 A structs namespace
- 12.8 The #as directive
- 12.9 Using a structs namespace for better storage management

- 12.10 Pointer to struct
- 12.11 Struct alignment
- 12.12 Making definitions in an inner module visible with using
- 12.13 Struct parameters
 - 12.13.1 Type as a struct parameter
- 12.14 Structs with relative pointers

13 - Unions and enums

- 13.1 Working with unions
- 13.2 Working with enums
- 13.3 Enum as a namespace
- 13.4 Enum as #specified
- 13.5 enum_flags and masking flags
- 13.6 Some useful enum methods

14 - Branching with if else

- 14.1 The if-else statement
 - 14.1.1 One-liners
 - 14.1.2 The classical C error
- 14.2 Ternary operator ifx
- 14.3 Case branching
 - 14.3.1 Using if-case with enums and #complete
- 14.4 Test on empty variables
- 14.5 Other useful if tests

15 - Looping with while and for

- 15.1 While loop
 - 15.1.1 Nested while loops
 - 15.1.2 Named while-loops
 - 15.1.3 Printing out a recursive list
- 15.2 For loop
- 15.3 Breaking out or continuing a loop
- 15.4 Looping over an enum's values
- 15.5 Looping over a structs fields with type_info()
- 15.6 Serialization
- 15.7 Annotations or notes

16 - Types in depth

- 16.1 Definition of Any
- 16.2 Type_Info and Type_Info_Tag
- 16.3 Ways to dig into type information
 - 16.3.1 Cast to Any, .type and .type.type
 - 16.3.2 The type_info() proc
 - 16.3.3 Checking whether an enum is #specified
 - 16.3.4 Checking whether a struct uses Vector3 with #as

17 - Basics of procedures

- 17.1 Declaring and calling a proc
 - 17.1.1 Exiting from a proc with return
 - 17.1.2 Getting the type and address of a proc
- 17.2 Local procs
- 17.3 Difference between passing a copy and passing a pointer
- 17.4 Default values for arguments
- 17.5 Named arguments
- 17.6 #must and multiple return values
 - 17.6.1 Named and default return values
 - 17.6.2 The #must directive
 - 17.6.3 Example proc: file_open
- 17.7 Overloading procedures
 - 17.7.1 Overloading in global and local scope
- 17.8 Inlining procs
- 17.9 Recursive procs
 - 17.9.1 The #this directive
 - 17.9.2 Recursive structs and #this
- 17.10 Swapping values
- 17.11 A println procedure
- 17.12 Autocasting a parameter with xx
- 17.13 Structs and procs
 - 17.13.1 Using the namespace of a struct in procs
 - 17.13.2 The #as directive in proc arguments
- 17.14 Reflection on procedures
 - 17.14.1 The #procedure_name directive
- 17.15 The #deprecated directive
- 17.16 Anonymous procs

18 - Arrays

18.1. Array literals

1	8.2.	For	qool	over	arrav	/S

18.3. Static arrays

- 18.3.1 Setting up an array with a for loop
- 18.3.2 Compile-time and run-time bounds check
- 18.3.3 Using an array as a boolean
- 18.3.4 Allocating an array on the heap

18.4. Dynamic arrays

- 18.4.1 Useful procs for dynamic arrays
- 18.4.2 Internal definition of a dynamic array

18.5. Array views

- 18.5.1 Changing the view and the base array
- 18.5.2 Misuse of array views with dynamic arrays

18.6. For-loops over arrays: more examples

- 18.6.1 Named index and value
- 18.6.2 Changing an array by iterating with a pointer
- 18.6.3 Reversing a for loop with <

18.7. Multidimensional arrays

18.8. Passing an array to a procedure

18.8.1 C's biggest mistake

18.9. An array of pointers

18.10 Variable number of arguments .. for a procedure

- 18.10.1 Passing an array as a variable argument
- 18.10.2 Named variable arguments proc
- 18.11 The print procedure uses a variable number of arguments
- 18.12 Array of structs

18B – Ordered remove in arrays

18C - Copying a struct with memcpy

19 – Working with strings

- 19.1 What are strings?
- 19.2 Some basic operations on bytes
- 19.3 Backslash codes, escape characters and Unicode characters
- 19.4 Some string characteristics
 - 19.4.1 String literals are immutable and bounds-checked
 - 19.4.2 Strings as boolean values
 - 19.4.3 Multi-line strings
 - 19.4.4 Looping over the characters in a string str with for
 - 19.4.5 The sprint procedure
 - 19.4.6 Releasing a string's memory
 - 19.4.7 Storing code in strings
 - 19.4.8 Strings as array views
 - 19.4.9 Relative strings

19.5 String builder
19.6 String operations
19.6.1 Conversions to and from numbers
19.6.1.1 string to numbers
19.6.2 String comparisons
19.6.3 Joining and splitting
19.6.3.1 Looping over the result of a split
19.6.4 Searching
19.6.5 Changing

19B - Get command-line arguments20 - Debugging

20.1 Some general strategies

20.1.1 Print debugging

20.1.2 Assert debugging

20.2 Debugging compile-time execution

20.2.1 #assert debugging

20.2.2 The compile-time interactive Jai debugger

20.2.3 The #dump directive

20.3 Debugging a run-time crash with an external debugger from Visual Studio

20.4 Debugging general code

20.5 Debugging with natvis

21 – Memory Allocators and Temporary Storage

21.1 Allocators

21.2 Temporary storage

21.3 Examples of using Temporary Storage

21.3.1 Storing strings in temp with tprint

21.3.2 Storing arrays in temp

21.3.3 Using New with temp

21.3.4 Using Temporary Storage on the Stack

21.3.5 How much memory is allocated in temp?

21.4 Memory-leak detector

22 Polymorphic Procedures

22.1 First example

22.1.1 What is \$T?

22.2 Some other examples

22.2.1 T used more than once, and also used as a return type

22.2.2 T as the type of an arrays items

22.2.3 Example with pointers: swapping

22.2.4 Example with structs

22.2.5 Example with several polymorphic types

- 22.3 The lambda notation =>
- 22.4 A procedure as argument of another proc
- 22.5 A recursive lambda as argument of a polymorphic proc
- 22.6 #bake_arguments, \$ and \$\$
- 22.7 A map function

23 Polymorphic arrays and structs

- 23.1 Polymorphic arrays
- 23.2 A more general map procedure
- 23.3 Polymorphic structs
- 23.4 Restricting the type of polymorphic proc arguments
- 23.5 The \$T/Object syntax
- 23.6 The \$T/interface Object syntax
- 23.7 The #bake_constants directive
- 23.8 Polymorphic struct using #this and #bake_constants

23B. Document types: a showcase of inheritance using structs, as and polymorphism

24 Operator overloading

- 24.1 Vector operators
- 24.2 Object operators

25 Context

- 25.1 push_context
- 25.2 push_allocator
- 25.3 What does #no_context mean?
- 25.4 Logging
- 25.5 Temporary storage
- 25.6 The stack trace
- 25.7 The print style

26 Meta-programming and macros

- 26.1 The type table
- 26.2 Running code at compile time with #run

26.2.1 The #compile_time directive

26.2.2 The #no_reset directive

- 26.3 Compiling conditionally with #if
- 26.4 Inserting code with #insert

26.4.1 Type Code and #code

26.5 Basics of macros

26.5.1 Using a macro with #insert

26.5.2 Using a macro with #insert to unroll a for loop

26.5.3 Using a macro for an inner proc

26.5.4 Using a macro with #insert,scope()

26.6 Using a for-expansion macro to define a for loop

26.7 A for-expansion macro for a double linked-list

26.8 The #modify directive

26.9 SOA (Struct of Arrays)

26.9.1 Data-oriented design

26.9.2 Making a SOA struct using #insert

26.10 How to get the generated source files after the meta-program step?

26.11 How to get info on the nodes tree of a piece of code?

26.12 The #placeholder directive

26.13 The #type directive and the VARIANT type

27 Working with Files

27.1 Basic file operations

28 Inline assembly

28.1 Examples of AVX and AVX2 SIMD operations

28.1.1 Assembly Feature Flags

28.2 Passing Inline Assembly Registers through Macro Arguments

28.3 Overview of Inline Assembly instructions

28.4 Assembly Language Data Types

28.4.1 Declaration of variables

28.4.2 List of different operations

28.4.3 List of registers

29 Interacting with C

- 29.1 Why would you call C?
- 29.2 How to call C? The #foreign directives
- 29.3 Mapping a dynamic library
- 29.4 Converting a C header (.h) file
- 29.5 Examples on Linux
- 29.6 Examples on Windows

29.6.1 Calling system library functions

29.6.2 Calling user-defined library functions

- 29.7 Callbacks and the #c_call directive
- 29.8 Getting the computer name: using #if, OS and C interaction

30 Integrated build system

- 30.1 Workspaces
- 30.2 The source file location directives
- 30.3 A minimal build file
- 30.4 The build options
 - 30.4.1 The optimization level
 - 30.4.2 The output type
 - 30.4.3 The output executable name
 - 30.4.4 The backend options
 - 30.4.5 Info about runtime errors and crashes
 - 30.4.6 Checks at runtime
 - 30.4.7 runtime_storageless_type_info
 - 30.4.8 Optimizing LLVM or X64 build
 - 30.4.9 Debug- and Release builds
- 30.5 Changing the default metaprogram
- 30.6 Intercepting the compiler message loop
- 30.7 Building and running on successful compilation
- 30.8 Building and running with a compiler command-line argument
- 30.9 Choosing a debug / release build with compiler command-line arguments
- 30.10 Enforcing coding standards
- 30.11 Generating LLVM bitcode
- 30.12 Using notes to do special metaprogramming

31 Working with Threads

- 31.1 Basics of threads
- 31.2 Building a program using OpenGL, macros and threads

50 The guessing game

Larger example programs:

- 31.2 Building a program using OpenGL, macros and threads
- 50.1 The guessing game

23B. Document types: a showcase of inheritance using structs, as and polymorphism
