

Virtual Memory

A Project for CS854

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Proposal

Our proposal has 3 parts:

Proposal

Our proposal has 3 parts:

1. Literature Review

Proposal

Our proposal has 3 parts:

1. Literature Review
2. Experimental Design

Proposal

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1. Literature Review
2. Experimental Design
3. Implementation

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Proposal: Literature Review

We wish to investigate the following operating systems:

Proposal: Literature Review

We wish to investigate the following operating systems:

1. Linux

Proposal: Literature Review

We wish to investigate the following operating systems:

1. Linux
2. OpenBSD

Proposal: Literature Review

We wish to investigate the following operating systems:

1. Linux
2. OpenBSD
3. OpenIndiana
(Previously Solaris)

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For each OS, we wish to answer the following questions:

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Proposal: Literature Review

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- ▶ Are there data structures for physical pages, separate from the page tables?

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- ▶ Are there data structures for physical pages, separate from the page tables?
- ▶ How are contiguous regions of memory managed?

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- ▶ How is memory freed?

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 - ▶ What happens when the kernel runs out of memory?

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For each OS, we wish to answer the following questions:

- ▶ How is physical memory managed?
- ▶ Are there data structures for physical pages, separate from the page tables?
- ▶ How are contiguous regions of memory managed?
- ▶ How is memory freed?
 - ▶ What happens when the kernel runs out of memory?
- ▶ Do they do anything special on Non-Uniform Memory Access (NUMA) architectures?

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Proposal: Experimental Design

Proposal: Experimental Design

- ▶ Make a *testable* hypothesis based on lit. review

Proposal: Experimental Design

- ▶ Make a *testable* hypothesis based on lit. review
- ▶ Design *simple* experiments to test this hypothesis

Proposal

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Proposal

Our proposal has 3 parts:

1. Literature Review
2. Experimental Design
3. **Implementation**

Proposal: Implementation

Proposal: Implementation

- ▶ Implement a memory management system for KOS

Progress

We have made some progress:

- ▶ OpenBSD data structures

Progress: OpenBSD

► 386BSD



NetBSD



OpenBSD

Progress: OpenBSD

- ▶ 386BSD



NetBSD



OpenBSD

- ▶ VM based on NetBSD

Progress: OpenBSD

- ▶ 386BSD



NetBSD



OpenBSD

- ▶ VM based on NetBSD
 - ▶ Rewritten in 1998

Progress: OpenBSD

- ▶ 386BSD



NetBSD

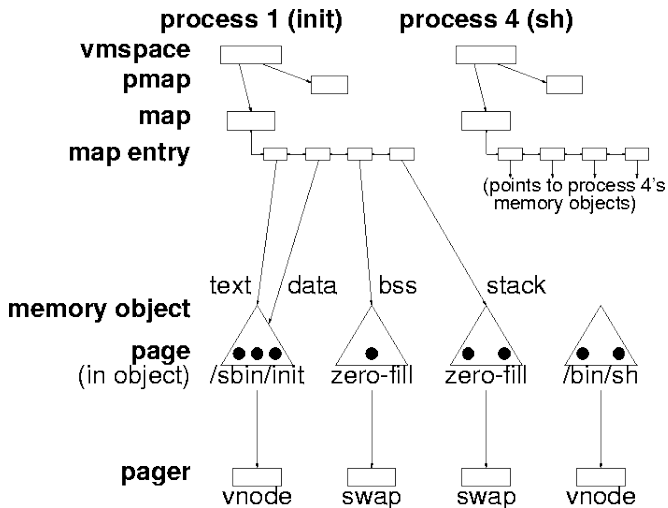


OpenBSD

- ▶ VM based on NetBSD
 - ▶ Rewritten in 1998
 - ▶ 270 page PhD dissertation

Progress: OpenBSD

- ▶ 386BSD
 - ↓
- NetBSD
 - ↓
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Progress: OpenIndiana

1. Open source fork of OpenSolaris after Oracle take over
2. Stewarded by the Illumos Foundation
3. VM uses the ast package by AT&T, written by Kiem-Phong Vo
4. Based on paper "Vmalloc: A General and Efficient Memory Allocator"

Progress: OpenIndiana

1. Legacy malloc function is old, has shortcomings
2. malloc not designed for modern environments
3. Vmalloc a memory allocation library that is flexible and allows a wide range of memory operations
 - 3.1 Regions to organize memory
 - 3.2 Obtain memory by application definable disciplines
 - 3.3 Customize memory management

Summary

1. Literature Review
 - ▶ Some progress on data structures!
2. Experimental Design
3. Implementation

References

- ▶ UVM dissertation:
<http://vorpal.math.drexel.edu/course/opsys2/uvm-project/uvm.pdf>
- ▶ Vmalloc: A General and Efficient Memory Allocator:
<http://onlinelibrary.wiley.com/doi/10.1002/%28SICI%291097-024X%28199603%2926:3%3C357::AID-SPE15%3E3.0.CO;2-%23/abstract>

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