Composing Component Tests

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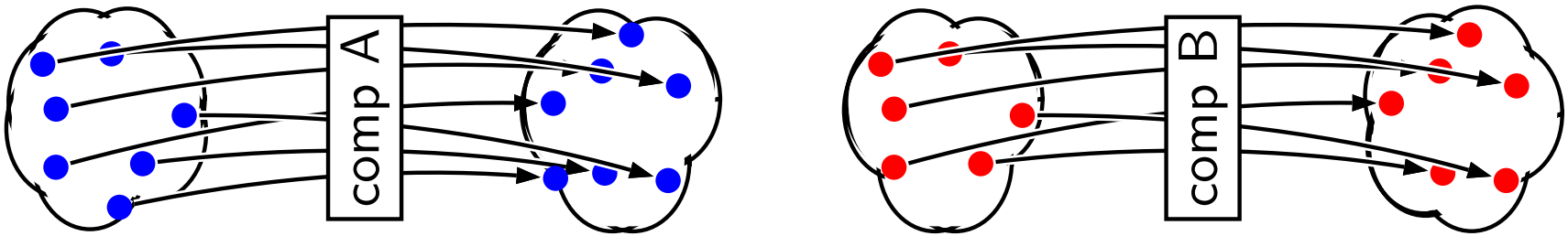
The Setting (== Unsupported Biases?)

- Testing is at best a craft
  - It often works on small units
  - It often fails on larger systems
- Components (==‘executables’) are ideal ‘units’
- Subdomain-testing theory explains all
- Tools support revealing experiments
- Series composition is fundamental

Unit Tests Don't Compose

Unit testing two components A and B



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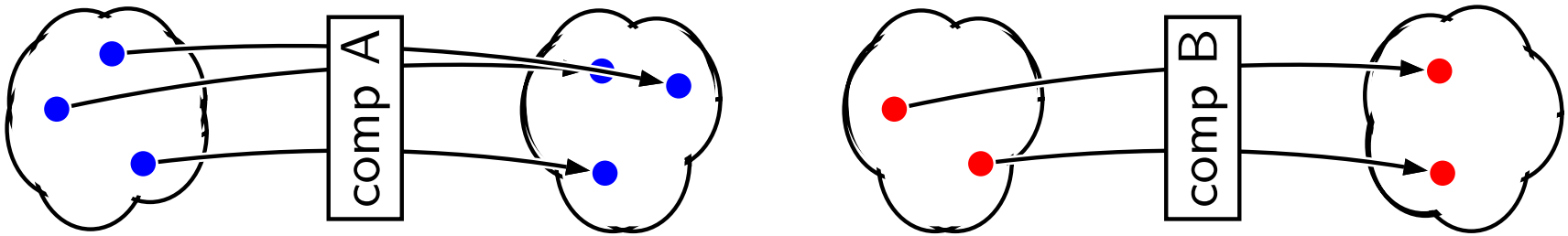

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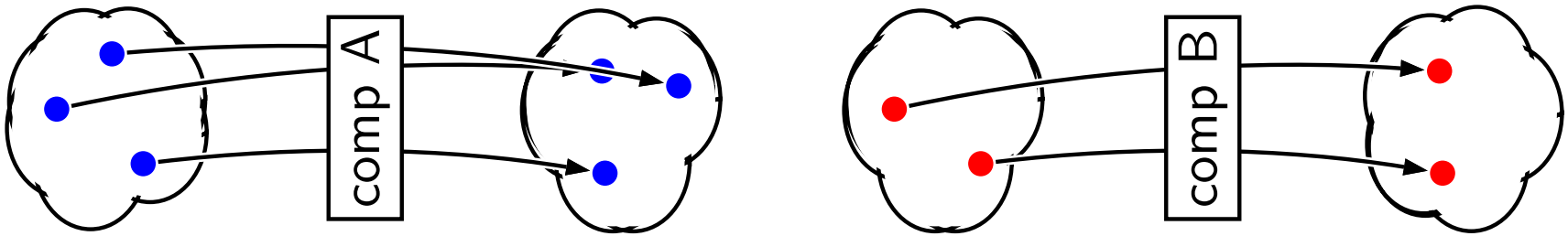
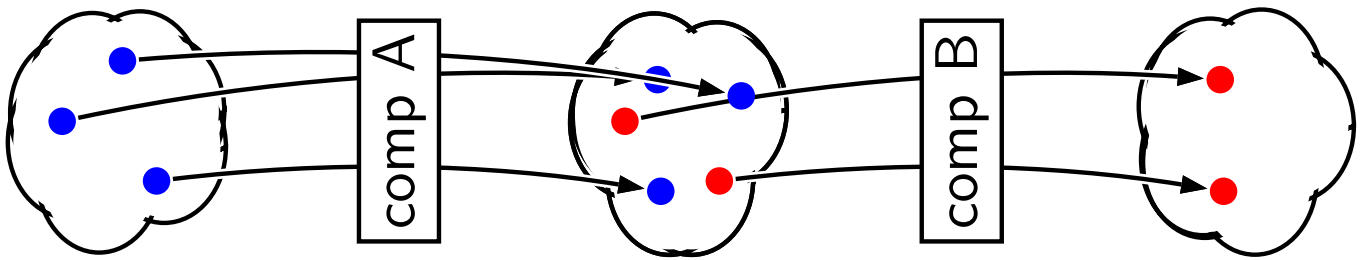


Series combination (interface mismatch)



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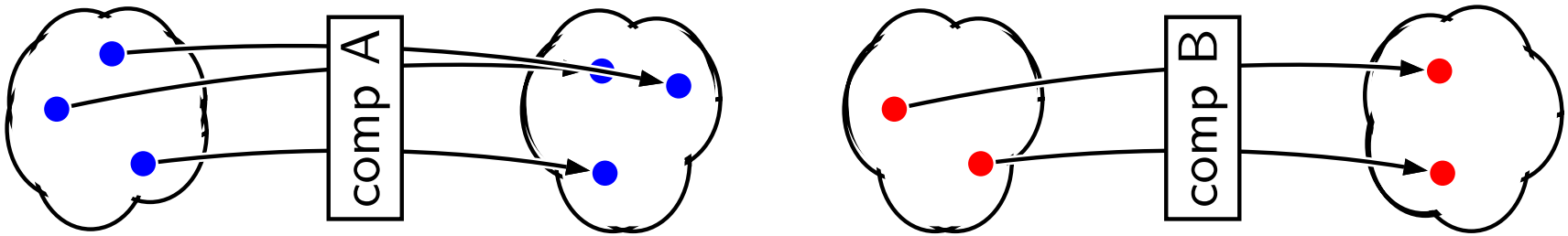

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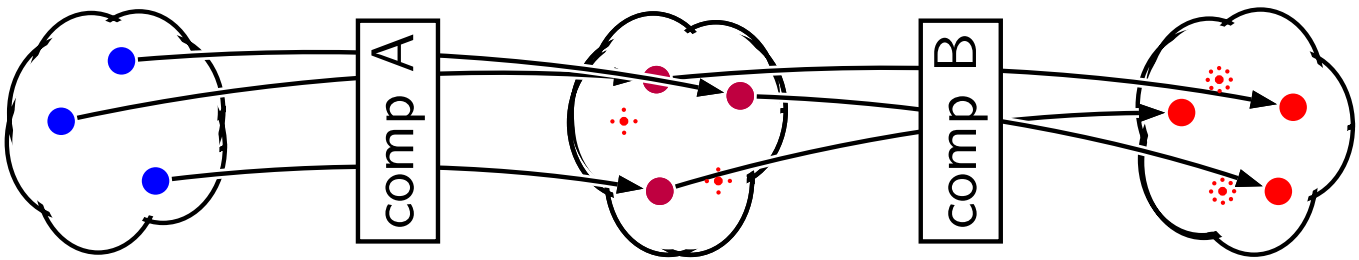

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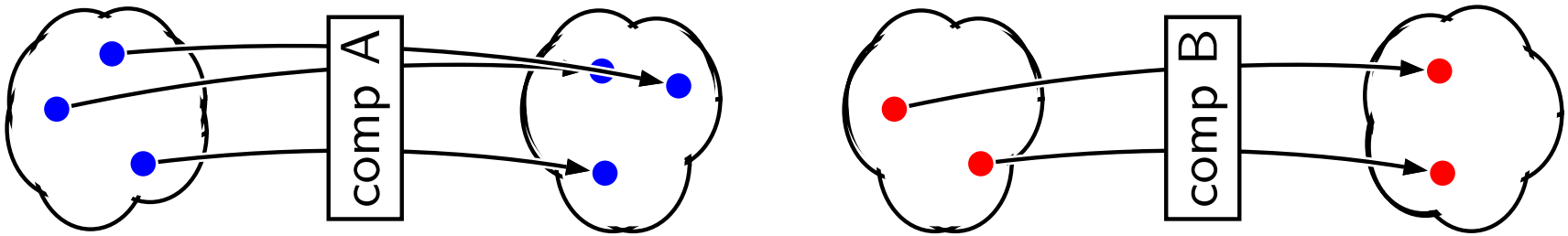

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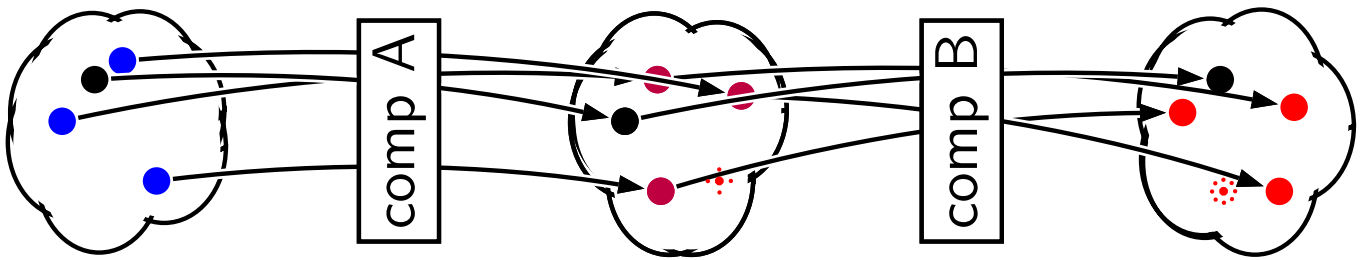

System fails because B test is poor

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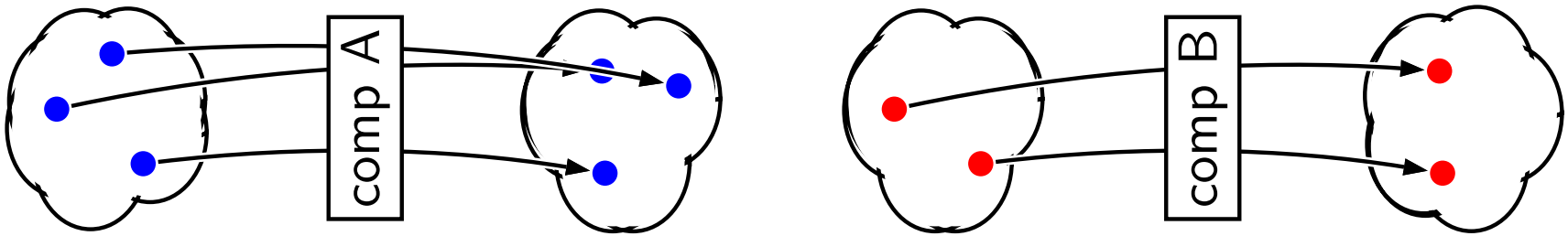

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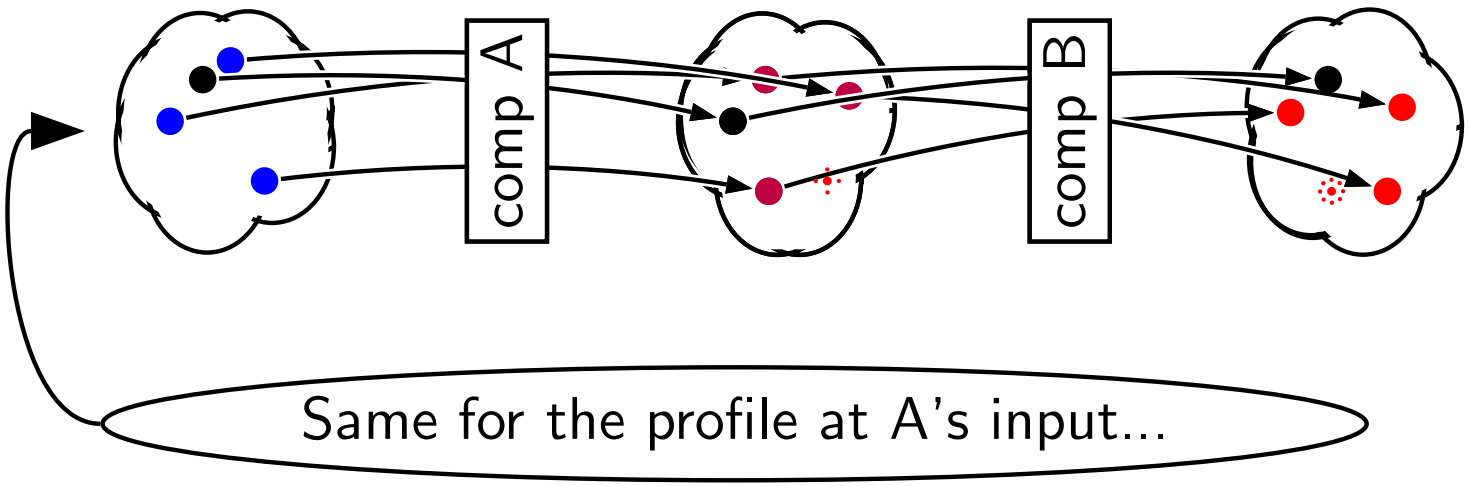

Subdomains to the Rescue!

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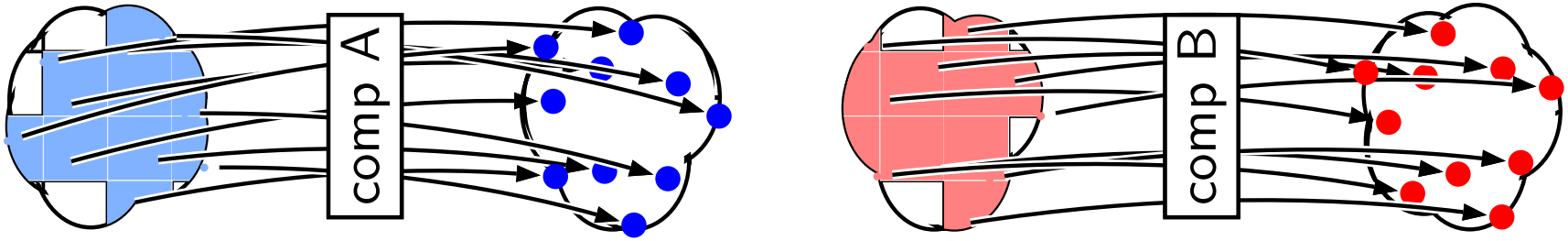

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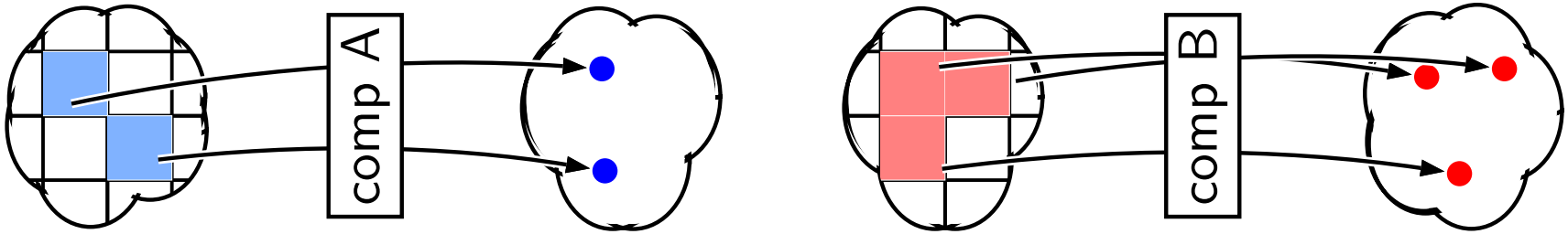

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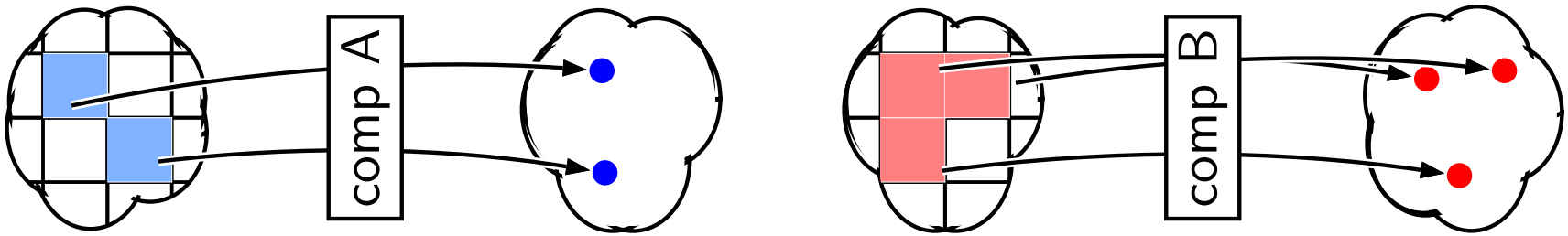

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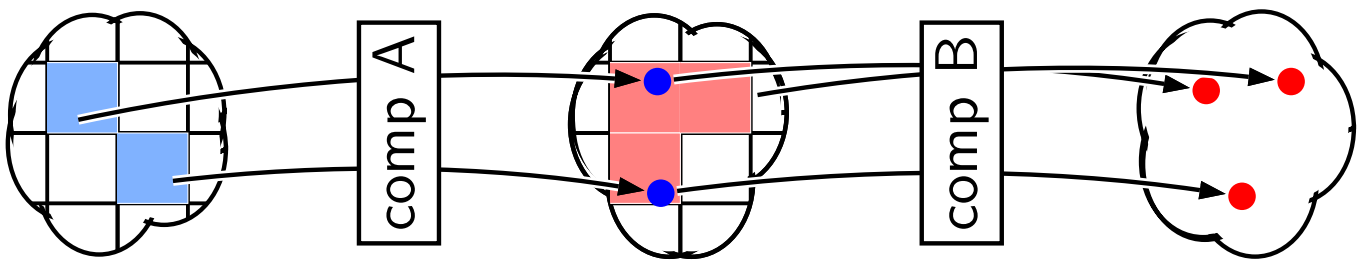

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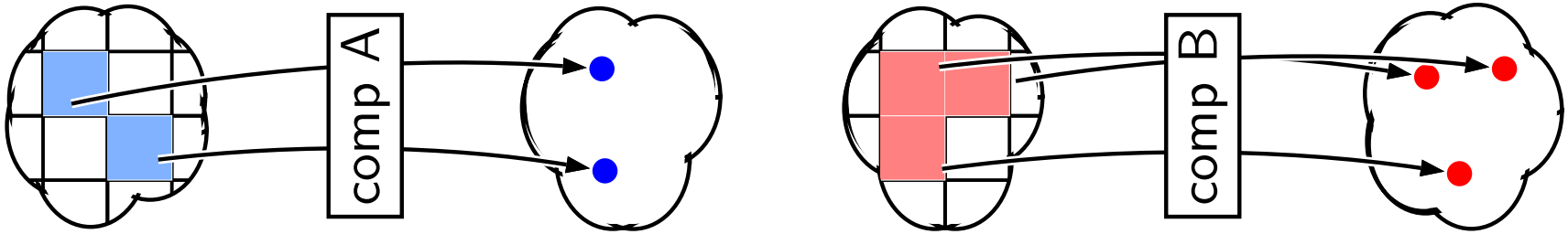

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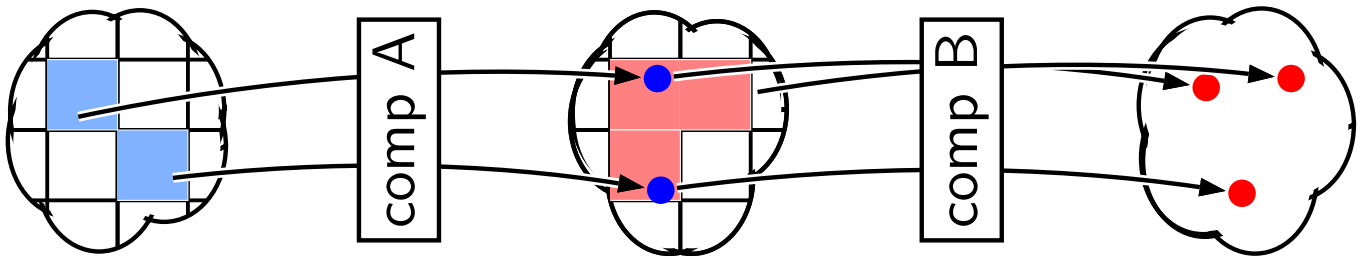

Testing in isolation:

- Component B need not know what Component A will send
- Component A need not know what profile it will see

Tool-supported Component-based Development

1. Develop components → Repository
   - Write component code
   - *Test code to specification*
   - Choose good subdomains
   - *Approximate with subdomain test*

Key:
(Blue) Human, by-hand *(Red slant) Tools, automatic*

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2. Design system
   - Select components from repository (bottom-up design)
   - *Synthesize system approximation*
   - *Check against system specification*

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3. Buy components, build system
   - ~~Test system against specification~~

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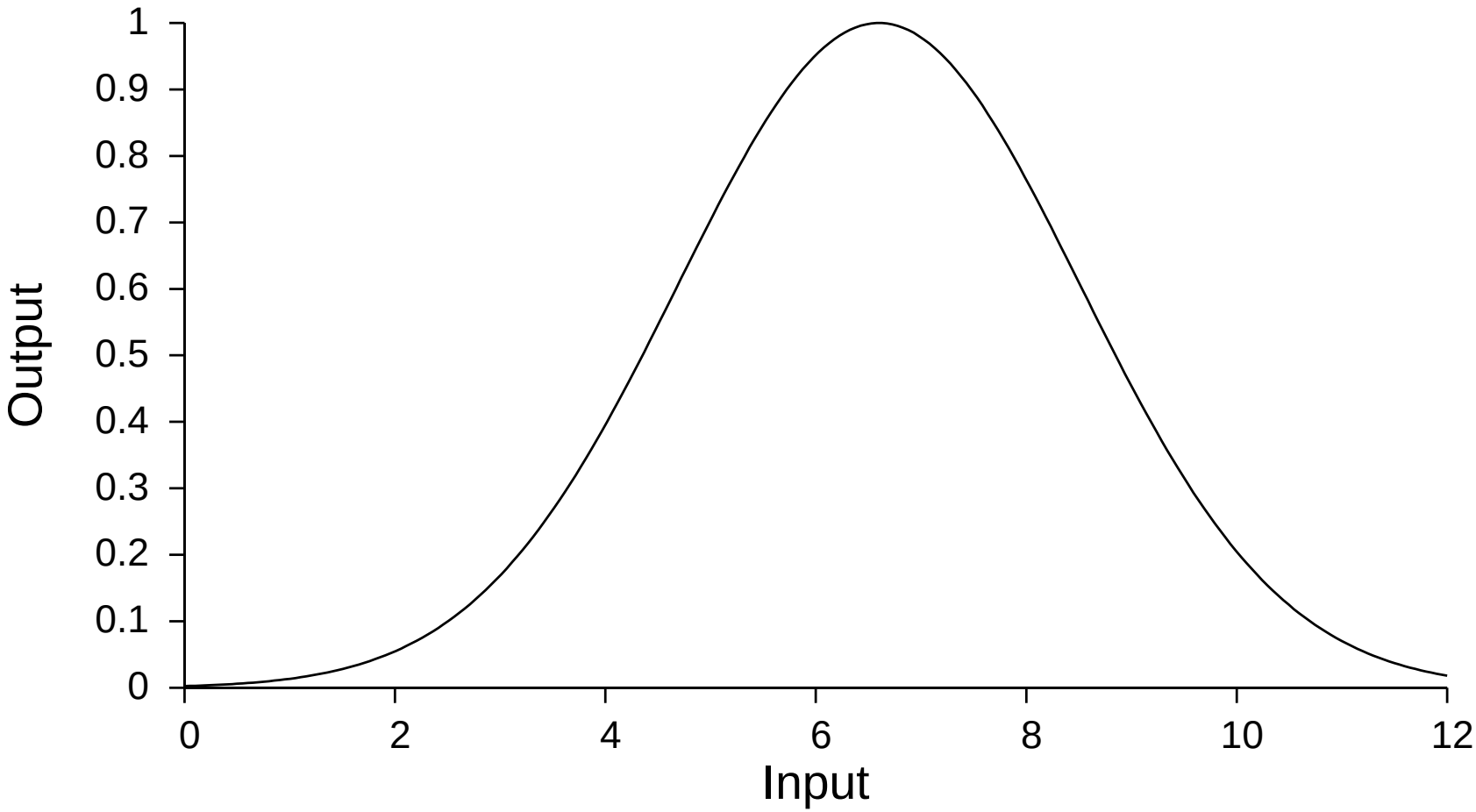
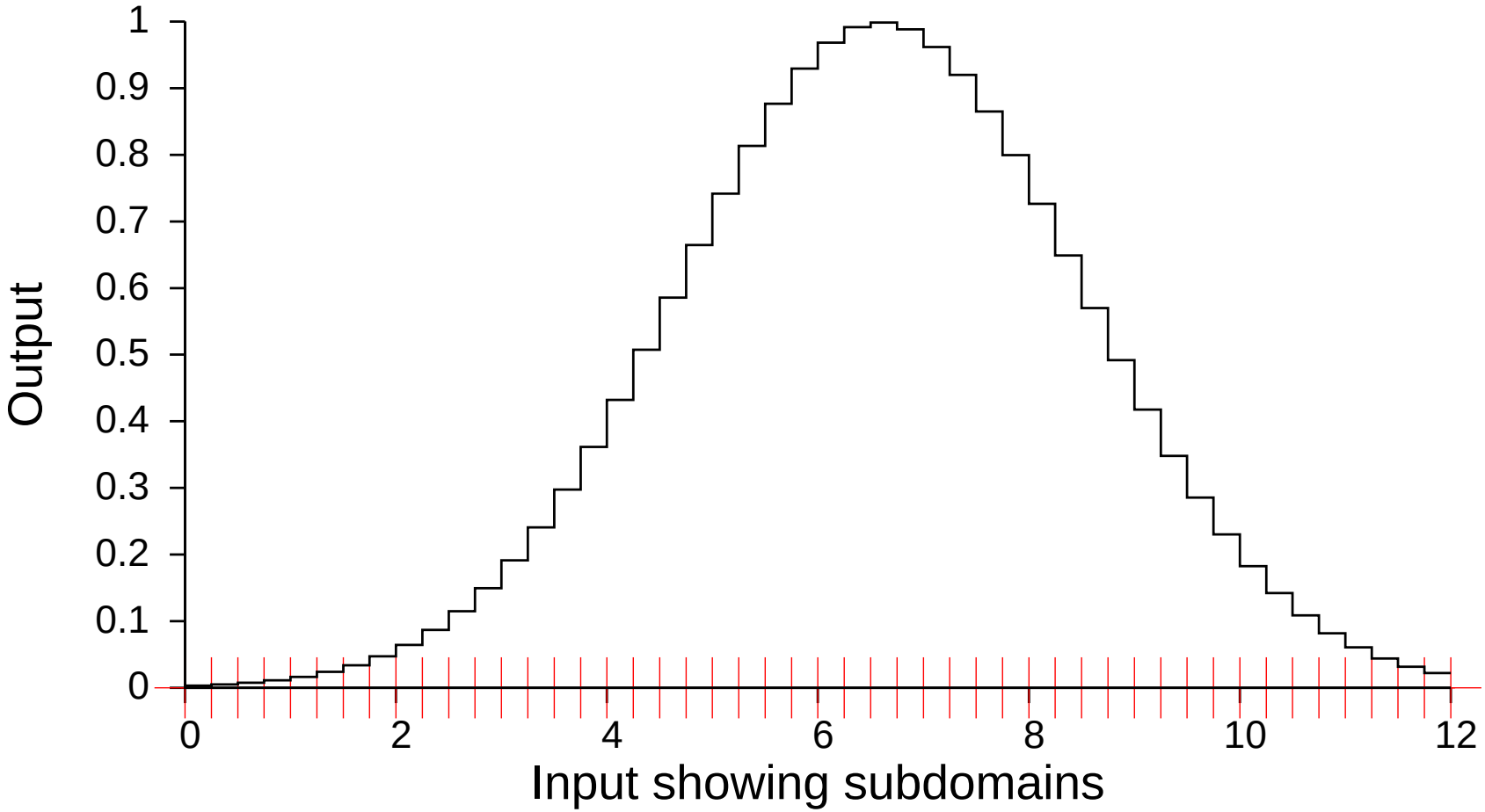
Develop and Approximate Components

Component '`Bell`' measurement:
Gaussian, $\mu = 6.6, \sigma = 2.7$, 142 equispaced tests:



Develop and Approximate Components

Approximation measurements
(3 samples in each of 48 subdomains):

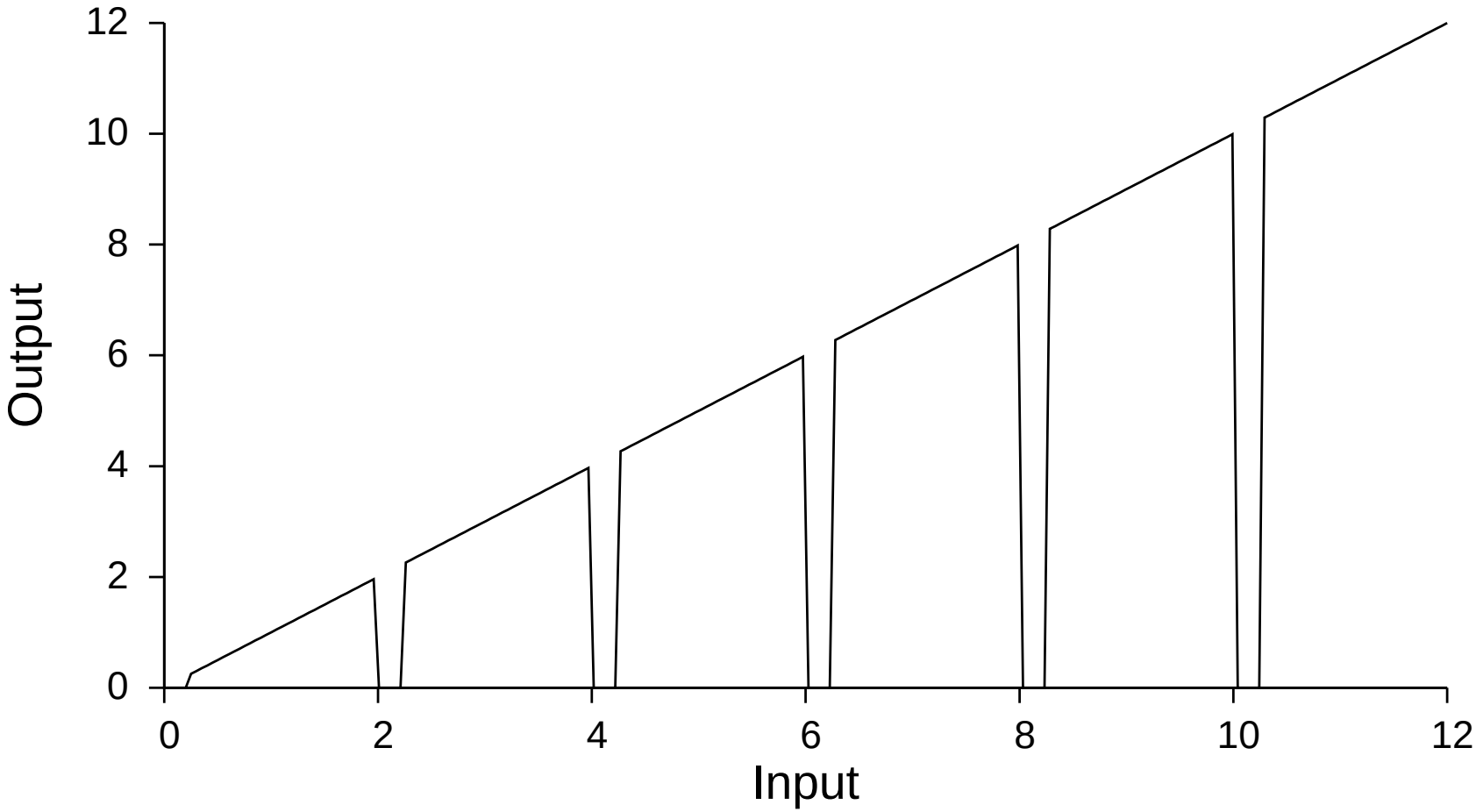


R-M-S error ranges from 0.1% to 4.3% by subdomain

Develop and Approximate Components

Component '`Chop`' measurement:

Chopping function, 142 equispaced tests:



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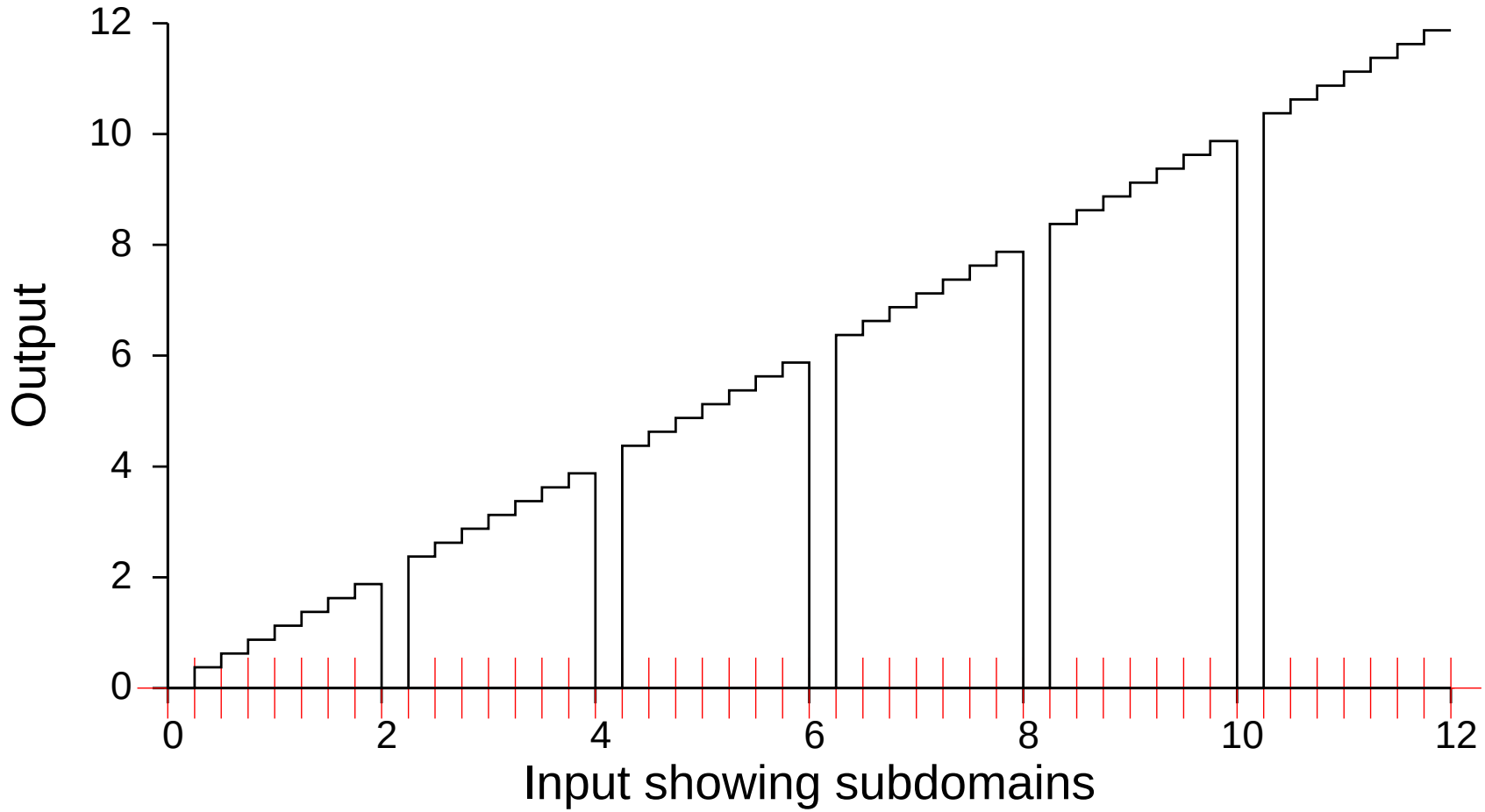
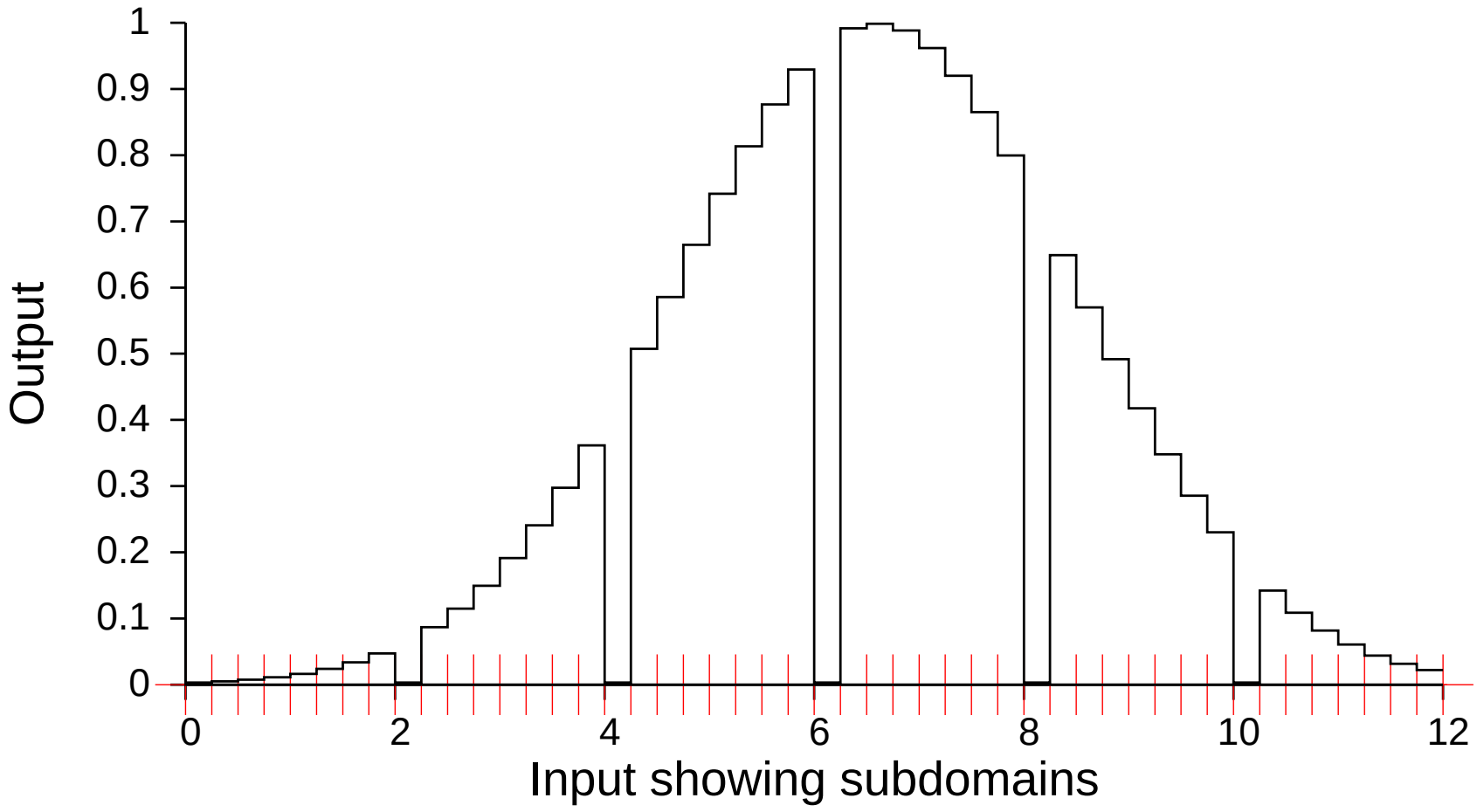


R-M-S error ranges from 0 to 1.1% by subdomain

Series System Synthesis Prediction

Prediction for system `Chop; Bell`:



Synthesis is fast (5X execution)

R-M-S prediction error 0.1% – 4.5%

Now for Some Content: Research Questions

1. Can non-functional properties (run time, reliability, ...) be synthesized?
2. Can complicated systems be synthesized?
3. What happens as subdomains shrink and move?
4. Suppose the components have persistent state?
5. Suppose the components execute concurrently?
6. How about non-trivial examples?
7. How do the tools work?

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TIME'S UP!

Try a Journal

- Most research doesn't break into 10-page papers
  at yearly intervals
- Conference referees are volunteers in a thankless job, but...
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For those Research Questions...

- Read the paper in the forthcoming issue of TOSEM
- Or do it yourself – free tools and experiment data at `www.cs.pdx.edu/~hamlet/components.html`