Shooting method:

- Easy
- Breakable: may fail to converge, as root-finding may be unstable.

Finite difference method

<table>
<thead>
<tr>
<th>( u_n(x) )</th>
<th>( f(x) )</th>
<th>( u(0) = a )</th>
<th>( u(1) = b )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( u_0 )</td>
<td></td>
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<tr>
<td>( u_1 )</td>
<td></td>
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<tr>
<td>( u_2 )</td>
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</tbody>
</table>

Replace: (e.g.)

\[ u'(x) = \frac{u(x+h) - u(x-h)}{2h} \]
\[ u''(x) = \frac{u(x+2h) - 2u(x) + u(x-h)}{h^2} \]

What happens here?

5-wide stencil. Possibility: biased stencil.

\[ u_0 - 2u_1 + u_2 = r_1 \]
\[ u_1 - 2u_2 + u_3 = r_2 \]
Galerkin / finite elements

\[ u''(x) = f(x) \quad \Rightarrow \quad u''(x) - f(x) = 0 \]

\[ u(x) = \sum_{i=1}^{n} a_i \varphi_i(x) \]