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Heat Simulation of A Chip with Various Method

EC500

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Introduction

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- Temperature simulation over time with three methods:
  - Jacobi Iteration
  - Multigrid
  - Conjugate Gradient
- Parallelizing
- Compare the effectiveness and efficiency of the methods
- Compare the processes of reaching the stable status

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Heat Simulation

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$$\dot{q} = \rho c_p \frac{\partial T(x,y,t)}{\partial t} - \nabla \cdot (k \nabla T(x,y,t))$$

$$T[x,y,t+1] = (1-\alpha)T[x,y,t] + \alpha(T[x+h,y,t] + T[x-h,y,t] + T[x,y+h,t] + T[x,y-h,t])/4 + \alpha b(x,y)$$

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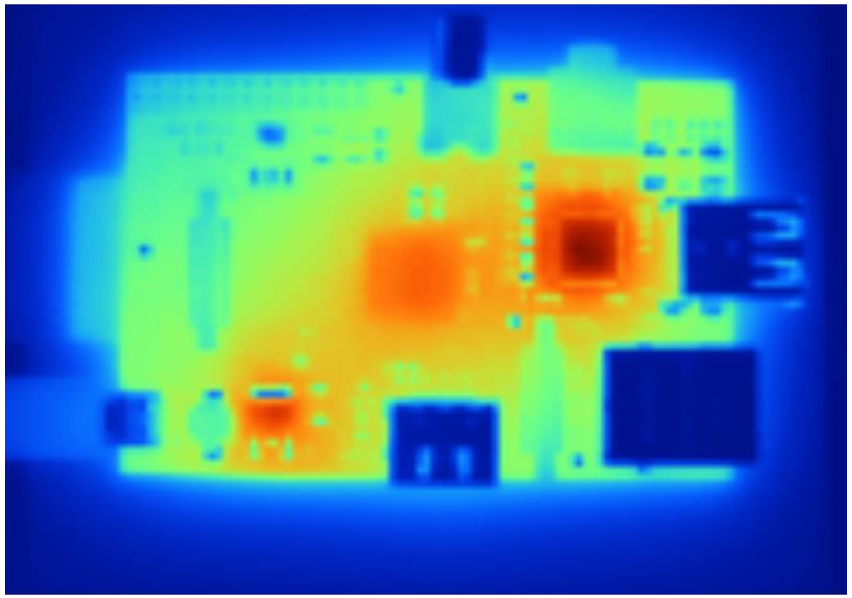

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Conjugate Gradient

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- To solve: $AX = b$, A is symmetric and positive definite

- Start with: $X_0 = 0$, $P_0 = b - AX_0$

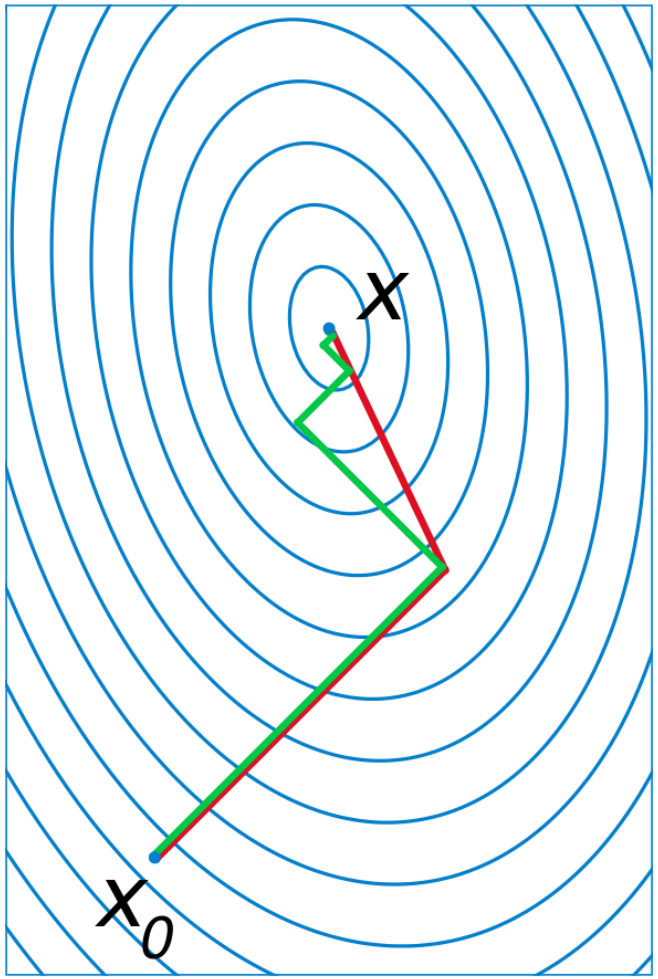
- Iterate:

  residue $r_k = b - Ax_k$

  direction $p_k = r_k - \sum_{i<k} \frac{p_i^T A r_k}{p_i^T A p_i} p_i$

  solution $x_{k+1} = x_k + a_k\, p_k$

  with $a_k = \frac{p_k^T r_k}{p_k^T A p_k}$



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References

- https://en.wikipedia.org/wiki/Conjugate_gradient_method
- https://makezine.com/2012/12/06/raspberry-pi-heat-maps/
- Class notes