

# A Topological Approach to Detecting Neighborhood Segregation

A Tale of Two Cities

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## Background

Washington, DC

Chicago

## The Math

## Conclusions



# Background

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# Spatial Demography and Segregation

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# Spatial Demography and Segregation

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  - Is demographic difference an existence proof?

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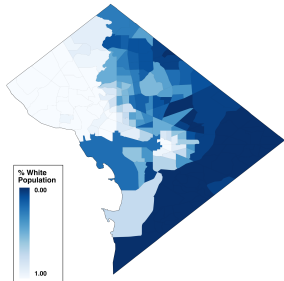
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- Census blocks grouped into census tracts (optimum size 4000 people)
- Demographic data captured on tract level



# Washington, D.C. Demographics

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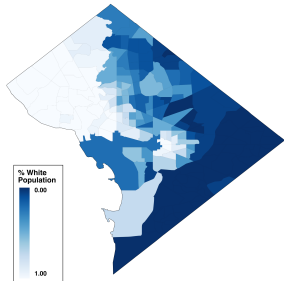
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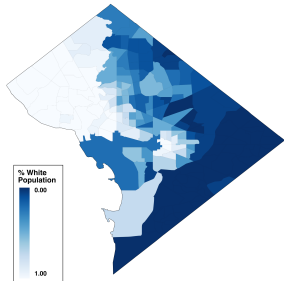
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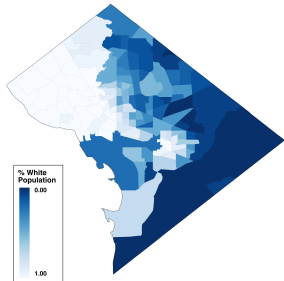
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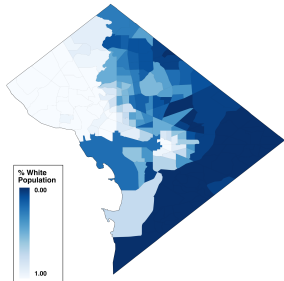
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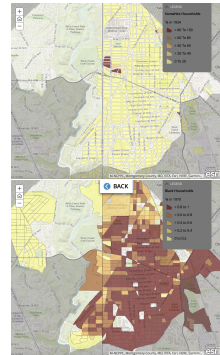
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- Increase in white, Asian, and Hispanic residents, and a decline in city's black population (New Great Migration)

# History of Segregation in Washington D.C.

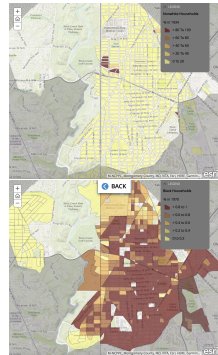
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**Figure 1:** Demographic changes to Ward 4 from 1934 to 1970

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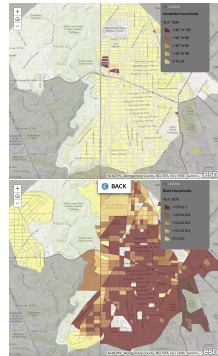
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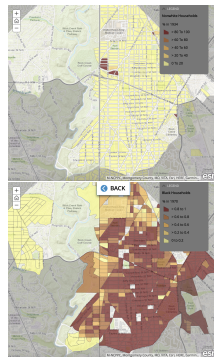


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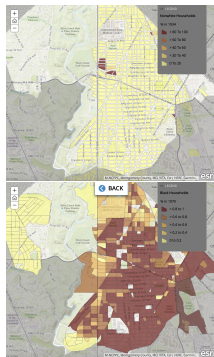
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- Extensive legal battles from early 1900s onward

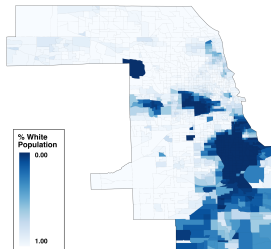


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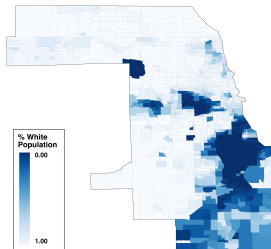
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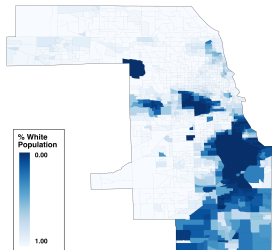
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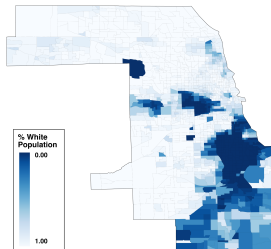
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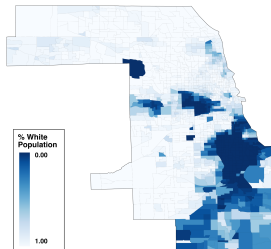
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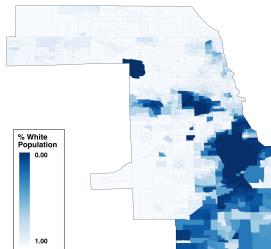
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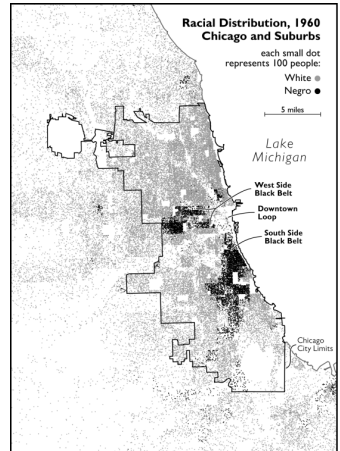


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- Large Irish American, Italian American, and Polish American population



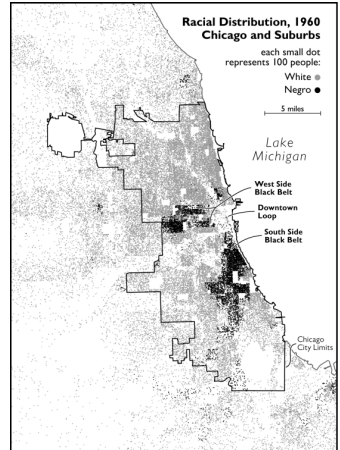
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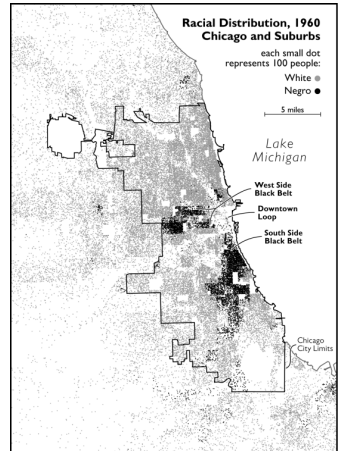
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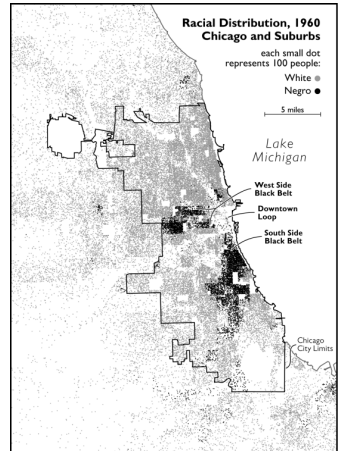
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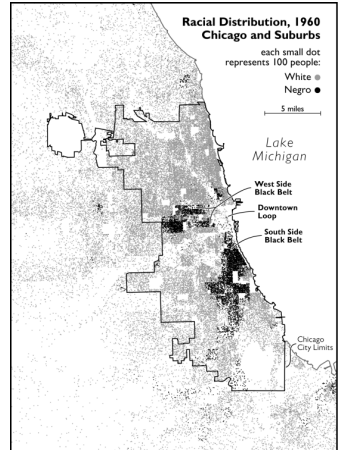
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- Highways used to segregate black communities



## The Math

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- We can think about these holes (features) as obstructions in the space (i.e., more features in the 0-th homology means the space has more connected components)
- Persistent homology tracks these features through a series of topological spaces

# Neighborhood Segregation as Topological Obstructions

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- Consider demographic space and possible “paths” through it
- Gradual demographic changes can be viewed as some possible paths
- Stark demographic changes do not admit paths, and therefore register as obstructions (and features in the homology group!)

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## Washington, D.C., demographic edges

## Washington, D.C., spatial edges

# Interpretations of Persistence — Demographic vs. Spatial Edges

# Interpretations of Persistence — All Groups vs. Binary Comparison

## Conclusions

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- Both methods correspond to observed segregation patterns in current cities

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- Identification of *de facto* vs. institutional segregation

## References

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**Questions?**