

Wed, March 29, 2023

Lecture #28

MSSC 6000

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## Announcements

- OHI today, 4:30pm - 5:30pm (Teams)
- \* HW 4 due Mon, Apr 3.
- \* Fri, Apr. 7 - no class
- Mon, Apr. 10 - no lecture (home work day)  
no OHI

## MH #3 n-trial steepest ascent

$x = \text{random element of } S$

while True:

temp = x

repeat n times:

s = tweak(x)

if score(s) > score(temp):

temp = s

x = temp

(temp is the best of n tweaks)

tweak = a random thing in the nbhd, (2)  
and there are many different  
ways to do that

When  $n=1$ , this is called  
"Hill Climbing"

MH #4: Hill Climbing

$x = \text{random element of } S$

while True:

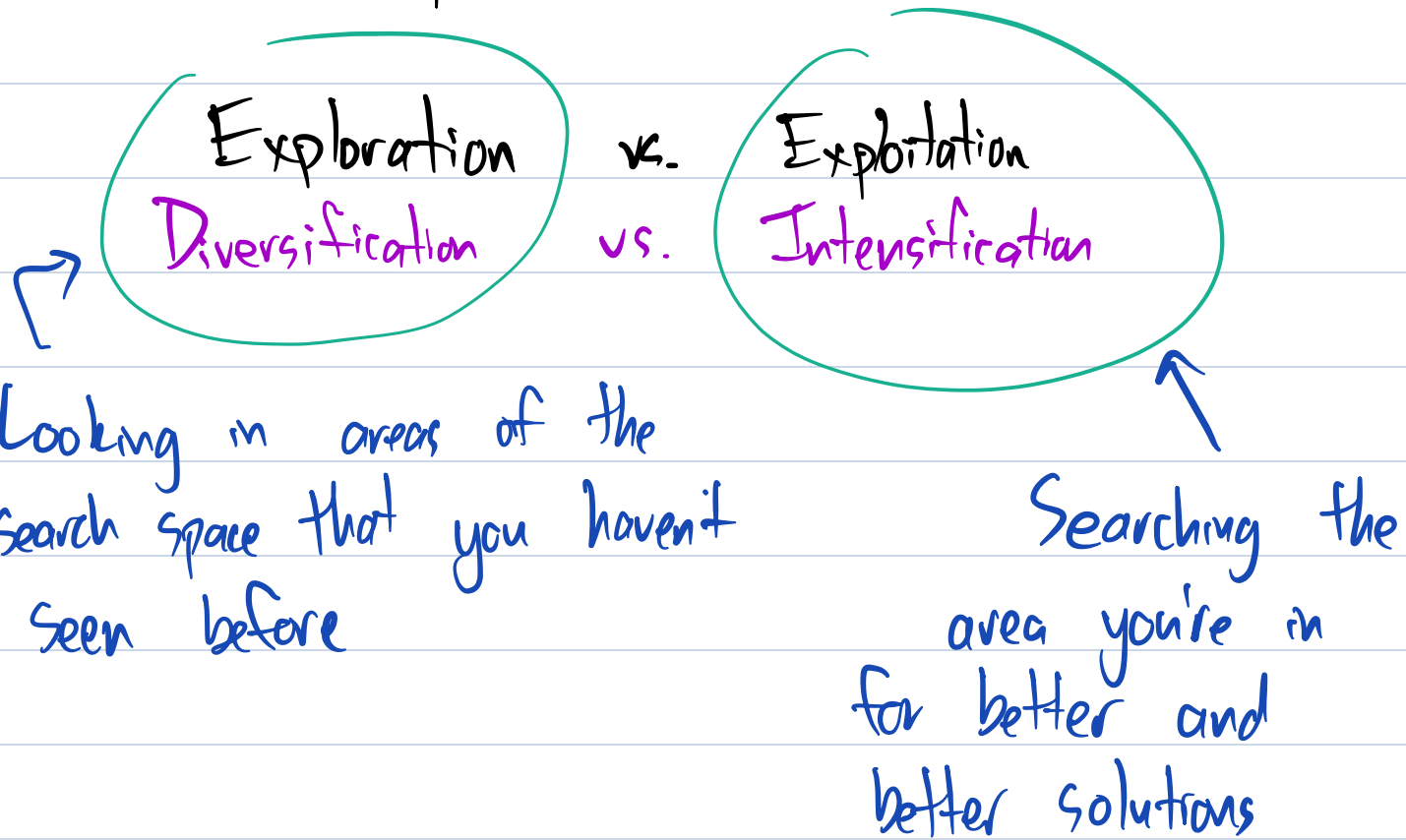
$s = \text{tweak}(x)$

if  $\text{score}(s) > \text{score}(x)$ :

$x = s$

<u>Hill Climbing Demo Results:</u>		<u>HC</u>	<u>Steepest Ascent</u> <u>HC</u>
50 cities, swap 2	8.428	9.878	
reversing block	6.7265	6.487	
300 cities, swap 2	29.4	32.83	
reversing block	14.6	14.36	

Limitation of Hill-Climbing: never allows a 3  
worse move, so that can trap you in parts  
of the search space.



Maximally exploitative: Steepest Ascent HC

Maximally explorative: Random Search

We want MHs that have some balance between these two

MHs = "the art of going downhill in a

smart way"

(4)

Two versions of HC that allow some downhill steps.

(1) Random Restarts

- \* Run HC for a while until you have not improved for some # of attempts
- \* Pick a new random starting place and start over

MH #5: HC with Random Restarts

best = random element of  $S$

while True:

$x$  = random element of  $S$

for some amount of time:

$s = \text{tweak}(x)$

if  $\text{score}(s) > \text{score}(x)$ :

$x = s$

if  $\text{score}(x) > \text{score}(\text{best})$ :

best = x

(5)

a preset # of tweaks

a preset amount of time

a preset # of non-improving tweaks

## (2) Probabilistic HC

Allow yourself to make a move that is downhill with some probability.

↳ fixed prob: okay,  
but not great

Next lecture: probability that a downhill move is allowed will adjust over time