Equal Access: Making your Department Accessible to Students with Disabilities

Richard Ladner
with panelists
Christian Vogler
Sangyun Hahn

UNIVERSITY OF WASHINGTON

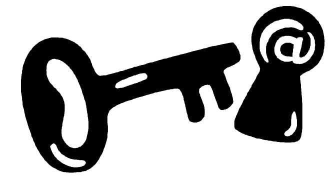
Plan for Today

- Keys to Success (15 minutes)
  – Richard Ladner
- Panel (40 minutes)
  – Sangyun Hahn
  – Christian Vogler
- AccessComputing Alliance (15 minutes)
- Working in small groups (20 minutes)
  – Review Department Accessibility Checklist

Some Basic Facts

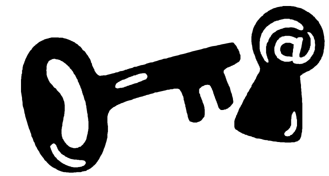
- 9% of the population in school, ages 14-21, have disabilities.
- 13% of undergraduate IT majors have disabilities.
- 5% of graduate IT majors have disabilities.
- .8% of IT doctorates have disabilities.
  - E.g. From 1999-2004 there were 53 in the US.
- 5% of employed IT scientists and engineers have disabilities.
  - As people age, the percentage of disabled in that age group grows.

Keys to Success



- Policy
- Attitudes
- Access Technology
- AccessComputing Alliance

Public Policy

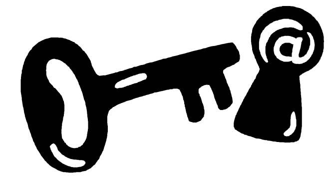


- **Public Law 94 -142 (1975) - Education of All Handicapped Children Act**
  - Renamed IDEA in 2004 for Individuals with Disabilities Education Act
  - All disabled children are entitled to equal access to education
  - This law may explain why the percentage of disabled students in IT at the undergraduate level appears so high.

University Policy

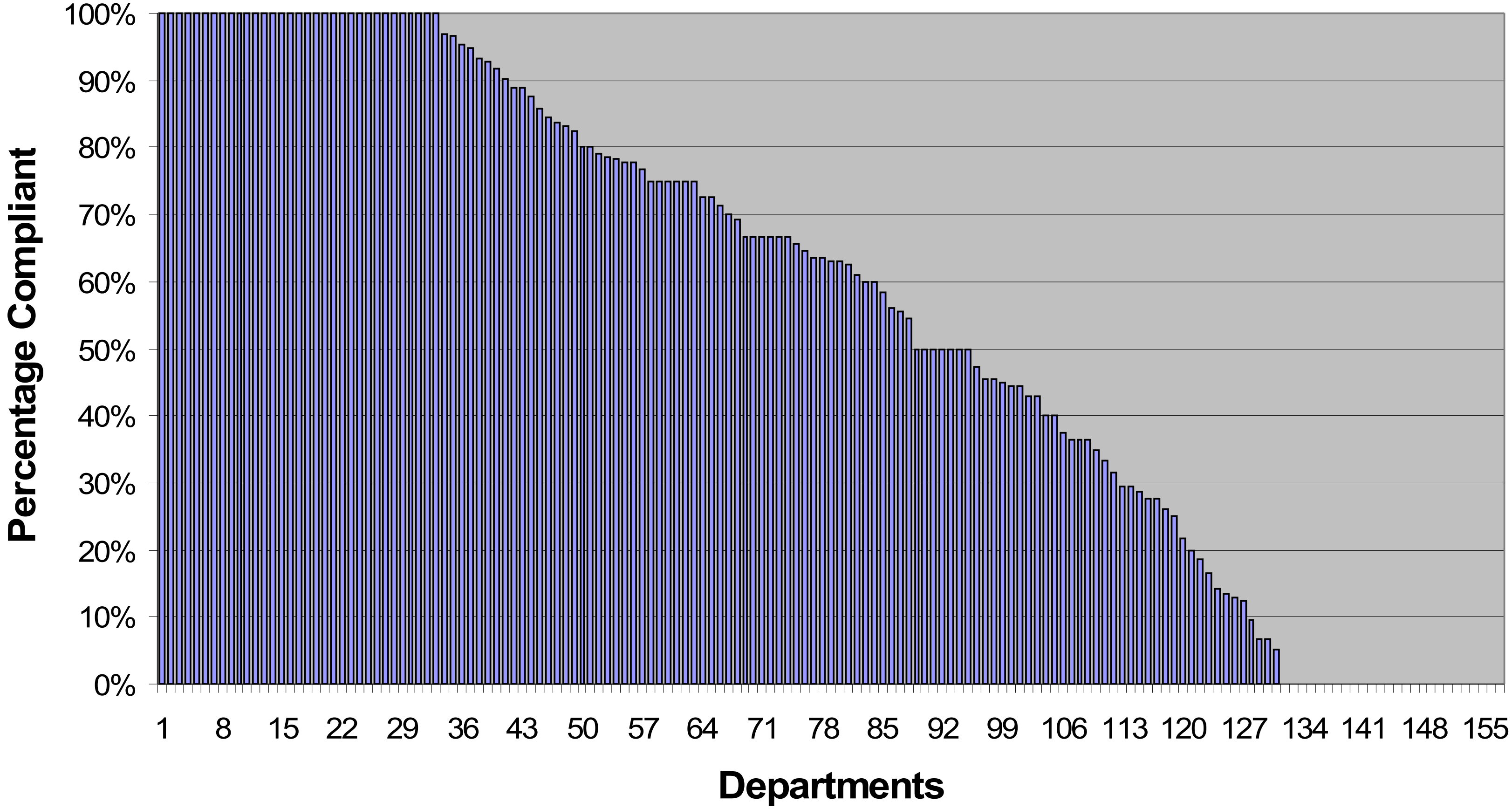
- Disabled student services office is well supported
- Promotional videos should be captioned
- No discrimination in hiring because of disability
- Web pages shall be accessible to screen readers

Departmental Access



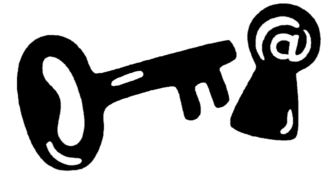
- Significant images should have alternate text using `alt`, `title`, or `longDesc` attributes in HTML of departmental homepages.
  - Alternate text enables screen readers to describe images for blind users.
- Summary of results
  - 157 departments from Taulbee report
  - 41 were at least 90% compliant
  - 26 were 0% compliant
  - 55% of all images on CS department homepages have alternative text.
- Full Results

Ordered by Compliance



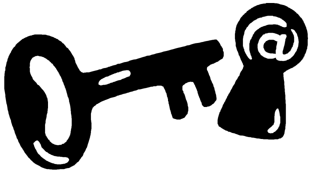
UNIVERSITY OF WASHINGTON

Attitudes

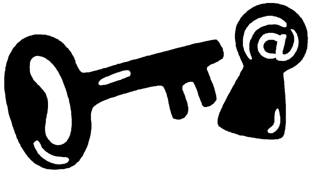


- From a faculty member on the admissions committee for blind applicant.
  - “It is going to be too hard for someone who is blind to get a Ph.D.”
- From a faculty member who was assigned blind TA.
  - “I don’t want him as a TA. I would have to do too much work for him.”

William A. Wulf 2000



"I believe that engineering is a highly creative profession. Research tells us that creativity does not spring from nothing; it is grounded in our life experiences, and hence limited by those experiences. Lacking diversity on an engineering team, we limit the set of solutions that will be considered and we may not find the best, the *elegant* solution."

Access Technology 

- Examples
  - Screen readers
  - Math readers
  - Alternative input devices
  - Captions
  - Tactile graphics
- Computer Science plays a big role in the development of these technologies.

UNIVERSITY OF WASHINGTON

Access to Text Books

Let's use this procedure to solve the application presented at the beginning of the lesson.

Define variables. Let x = the number of acres of crop A.
Let y = the number of acres of crop B.

Write inequalities.

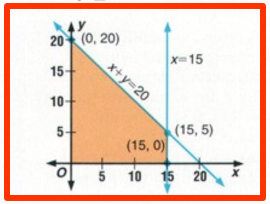
$x \geq 0,\ y \geq 0$ — *Acreage cannot be less than 0.*

$x \leq 15$ — *No more than 15 acres of crop A are permitted.*

$x + y \leq 20$ — *No more than 20 acres can be planted in all.*

graphics

Graph the system.



The constraints $x \geq 0$ and $y \geq 0$ tell you to consider only those points that are in Quadrant I.

The vertices are at (0, 0), (15, 0), (15, 5), and (0, 20).

Write an expression. Profit equals income less costs. The profit from crop A equals $600x - 120x - 15(5.60)x$, or $396x$. The profit from crop B equals $520y - 200y - 10(5.00)y$, or $270y$. Thus, the profit function is $P(x, y) = 396x + 270y$.

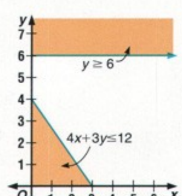
math

Substitute values.

$P(0,0) = 396(0) + 270(0) = 0$
$P(15,0) = 396(15) + 270(0) = 5940$
$P(15,5) = 396(15) + 270(5) = 7290$
$P(0,20) = 396(0) + 270(20) = 5400$

Answer the problem. The maximum occurs at (15, 5). Thus, Mr. Washington should plant 15 acres of crop A and 5 acres of crop B to obtain the maximum profit of $7290.

In certain circumstances, the use of linear programming is not helpful. Consider the graph at the right, based on the following constraints.



$x \geq 0$
$y \geq 0$
$y \geq 6$
$4x + 3y \leq 12$

text

The constraints do not define a region with any points in common in Quadrant I. When the constraints of a linear programming problem cannot be satisfied simultaneously, then **infeasibility** is said to occur. This may mean that the constraints have been formulated incorrectly, certain requirements need to be changed, or that additional resources are required before the problem can be solved.

Text

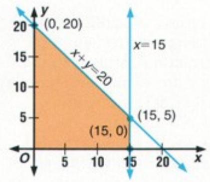
Let's use this procedure to solve the application presented at the beginning of the lesson.

Define variables. Let x = the number of acres of crop A.
Let y = the number of acres of crop B.

Write inequalities.

$x \geq 0,\ y \geq 0$ — *Acreage cannot be less than 0.*
$x \leq 15$ — *No more than 15 acres of crop A are permitted.*
$x + y \leq 20$ — *No more than 20 acres can be planted in all.*

Graph the system.



The constraints $x \geq 0$ and $y \geq 0$ tell you to consider only those points that are in Quadrant I.

The vertices are at (0, 0), (15, 0), (15, 5), and (0, 20).

Write an expression. Profit equals income less costs. The profit from crop A equals $600x - 120x - 15(5.60)x$, or $396x$. The profit from crop B equals $520y - 200y - 10(5.00)y$, or $270y$. Thus, the profit function is $P(x, y) = 396x + 270y$.

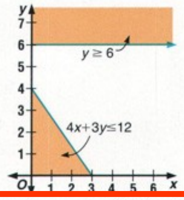
Substitute values.

$P(0,0) = 396(0) + 270(0) = 0$
$P(15,0) = 396(15) + 270(0) = 5940$
$P(15,5) = 396(15) + 270(5) = 7290$
$P(0,20) = 396(0) + 270(20) = 5400$

Answer the problem. The maximum occurs at (15, 5). Thus, Mr. Washington should plant 15 acres of crop A and 5 acres of crop B to obtain the maximum profit of $7290.

In certain circumstances, the use of linear programming is not helpful. Consider the graph at the right, based on the following constraints.

$x \geq 0$
$y \geq 0$
$y \geq 6$
$4x + 3y \leq 12$



The constraints do not define a region with any points in common in Quadrant I. When the constraints of a linear programming problem cannot be satisfied simultaneously, then **infeasibility** is said to occur. This may mean that the constraints have been formulated incorrectly, certain requirements need to be changed, or that additional resources are required before the problem can be solved.

Text Translation

Text Image

The constraints do not define a region with any points in common in Quadrant I. When the constraints of a linear programming problem cannot be satisfied simultaneously, then **infeasibility** is said to occur. This may mean that the constraints have been formulated incorrectly, certain requirements need to be changed, or that additional resources are required before the problem can be solved.

Optical Character Recognition (OCR)

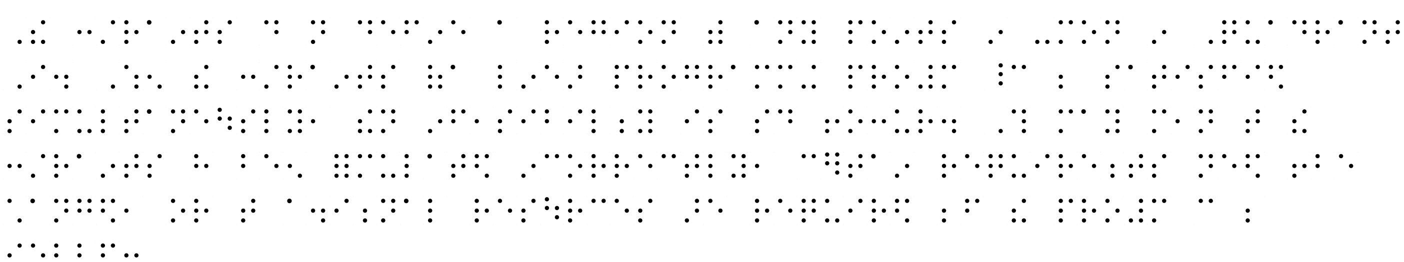
Text

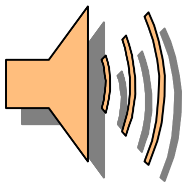
```
The constraints do not define a region with any points in common in Quadrant
I. When the constraints of a linear programming problem cannot be satisfied
simultaneously, then infeasibility is said to occur. This may mean that the
constraints have been formulated incorrectly, certain requirements need to be
changed, or that additional resources are required before the problem can be
solved.
```

Braille Translation (Duxbury)

Speech Synthesis (JAWS)

Braille





Speech

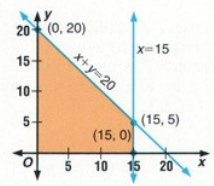
Math

Let's use this procedure to solve the application presented at the beginning of the lesson.

Define variables. Let x = the number of acres of crop A.
Let y = the number of acres of crop B.

Write inequalities.
$x \geq 0,\ y \geq 0$ *Acreage cannot be less than 0.*
$x \leq 15$ *No more than 15 acres of crop A are permitted.*
$x + y \leq 20$ *No more than 20 acres can be planted in all.*

Graph the system.



The constraints $x \geq 0$ and $y \geq 0$ tell you to consider only those points that are in Quadrant I.

The vertices are at (0, 0), (15, 0), (15, 5), and (0, 20).

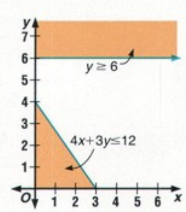
Write an expression. Profit equals income less costs. The profit from crop A equals $600x - 120x - 15(5.60)x$, or $396x$. The profit from crop B equals $520y - 200y - 10(5.00)y$, or $270y$. Thus, the profit function is $P(x, y) = 396x + 270y$.

Substitute values.
$P(0,0) = 396(0) + 270(0) = 0$
$P(15,0) = 396(15) + 270(0) = 5940$
$P(15,5) = 396(15) + 270(5) = 7290$
$P(0,20) = 396(0) + 270(20) = 5400$

Answer the problem. The maximum occurs at (15, 5). Thus, Mr. Washington should plant 15 acres of crop A and 5 acres of crop B to obtain the maximum profit of \$7290.

In certain circumstances, the use of linear programming is not helpful. Consider the graph at the right, based on the following constraints.

$x \geq 0$
$y \geq 0$
$y \geq 6$
$4x + 3y \leq 12$



The constraints do not define a region with any points in common in Quadrant I. When the constraints of a linear programming problem cannot be satisfied simultaneously, then **infeasibility** is said to occur. This may mean that the constraints have been formulated incorrectly, certain requirements need to be changed, or that additional resources are required before the problem can be solved.

Math Translation

Math Image

$$P(0,0) = 396(0) + 270(0) = 0$$
$$P(15,0) = 396(15) + 270(0) = 5940$$
$$P(15,5) = 396(15) + 270(5) = 7290$$
$$P(0,20) = 396(0) + 270(20) = 5400$$

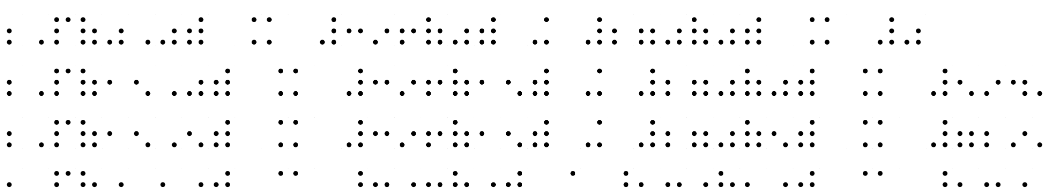
Math OCR (Infty Reader)

LaTex

```
\begin{eqnarray*}
P(0,0) = 396(0) + 270(0) = 0\\
P(15,0) = 396(15) + 270(0) = 5940\\
P(15,5) = 396(15) + 270(5) = 7290\\
P(0,20) = 396(0) + 270(20) = 5400
\end{eqnarray*}
```

Braille Translation (Duxbury)

Nemeth Code



Math Translation Examples

$$\sum_{i=0}^{\infty} x^i = \frac{1}{1-x}$$

```
\sum_{i=0}^\infty x^i = \frac{1}{1-x}
```

$$\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

```
\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}
```


UNIVERSITY OF WASHINGTON

Tactile graphics

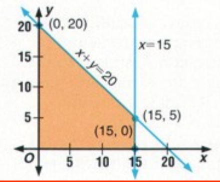
Graphics

Let's use this procedure to solve the application presented at the beginning of the lesson.

Define variables. Let x = the number of acres of crop A.
Let y = the number of acres of crop B.

Write inequalities.
$x \geq 0,\ y \geq 0$ — *Acreage cannot be less than 0.*
$x \leq 15$ — *No more than 15 acres of crop A are permitted.*
$x + y \leq 20$ — *No more than 20 acres can be planted in all.*

Graph the system.



The constraints $x \geq 0$ and $y \geq 0$ tell you to consider only those points that are in Quadrant I.

The vertices are at (0, 0), (15, 0), (15, 5), and (0, 20).

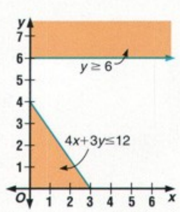
Write an expression. Profit equals income less costs. The profit from crop A equals $600x - 120x - 15(5.60)x$, or $396x$. The profit from crop B equals $520y - 200y - 10(5.00)y$, or $270y$. Thus, the profit function is $P(x, y) = 396x + 270y$.

Substitute values.
$P(0,0) = 396(0) + 270(0) = 0$
$P(15,0) = 396(15) + 270(0) = 5940$
$P(15,5) = 396(15) + 270(5) = 7290$
$P(0,20) = 396(0) + 270(20) = 5400$

Answer the problem. The maximum occurs at (15, 5). Thus, Mr. Washington should plant 15 acres of crop A and 5 acres of crop B to obtain the maximum profit of $7290.

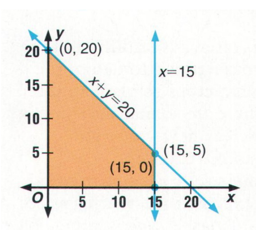
In certain circumstances, the use of linear programming is not helpful. Consider the graph at the right, based on the following constraints.

$x \geq 0$
$y \geq 0$
$y \geq 6$
$4x + 3y \leq 12$



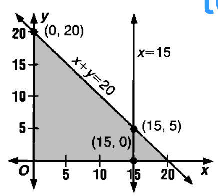
The constraints do not define a region with any points in common in Quadrant I. When the constraints of a linear programming problem cannot be satisfied simultaneously, then **infeasibility** is said to occur. This may mean that the constraints have been formulated incorrectly, certain requirements need to be changed, or that additional resources are required before the problem can be solved.

Graphic Translation



original scanned image

preprocess

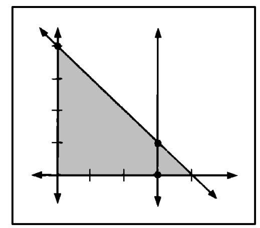


clean image

text extract

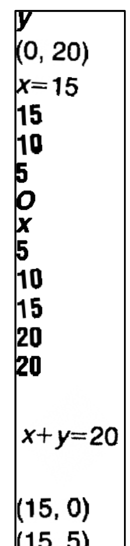
location file

<LocationInformation>
<NumLabels>16</NumLabels>
<Resolution>100.000000</Resolution>
<ScaleX>1.923077</ScaleX>
<ScaleY>1.953125</ScaleY>
-
<Label>
<x1>121</x1>
<y1>45</y1>
<x2>140</x2>
<y2>69</y2>
<Alignment>0</Alignment>
<Angle>3.141593</Angle>
</Label>



pure graphic

text image



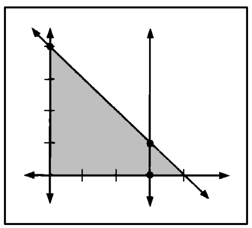
UNIVERSITY OF WASHINGTON

Tactile graphics

Graphic Translation

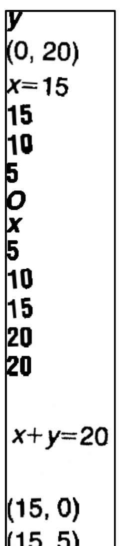
location file

<LocationInformation>
<NumLabels>16</NumLabels>
<Resolution>100.000000</Resolution>
<ScaleX>1.923077</ScaleX>
<ScaleY>1.953125</ScaleY>
-
<Label>
<x1>121</x1>
<y1>45</y1>
<x2>140</x2>
<y2>69</y2>
<Alignment>0</Alignment>
<Angle>3.141593</Angle>
</Label>



pure graphic

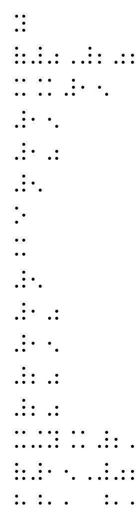
text image

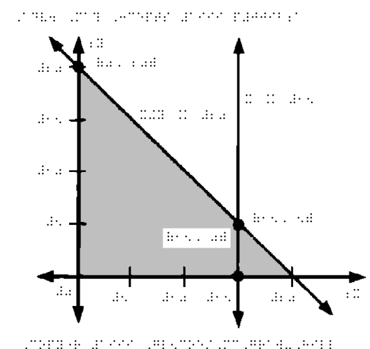


text

```
y
(0,20)
x=15
15
10
5
O
x
5
10
15
20
20
x+y=20
(15,0)
(15,5)
```

Braille





Automating the Process

- CS contributions
  - Machine learning
  - Computational geometry algorithms
  - Computer vision
  - Optimization algorithms
- Example
  - *Advanced Mathematical Concepts*, *Precalculus* by Gordon-Holliday, et al., Glencoe/McGraw-Hill, 1999
  - 1,080 figures
  - 6.5 minutes per figure

Panelists

- Christian Vogler –
  Perspectives of a Deaf Computer Scientist
  – Research Scientist, Gallaudet University
- Sangyun Hahn –
  Experiences of a Blind Computer Scientist
  – Ph.D. Candidate, University of Washington

AccessComputing

The goal is to increase the participation of people with disabilities in computing fields.

- NSF BPC funded
- Co-directors Sheryl Burgstahler and Richard Ladner
- Based at the University of Washington
- Partners from industry, organizations, other universities
- www.washington.edu/accesscomputing

Activities for Students

- College transition & bridge programs
- Tutoring
- Internships
- e-mentoring

Activities for Departments

- Communities of Practice (CoPs).
- Capacity-Building Institutes of stakeholders/gatekeepers.
- Computing Department Accessibility Checklist

Nationwide Resource

- AccessComputing Knowledge Base of FAQs,case studies, promising practices
- Multimedia training.
- Articles in scholarly journals & other periodicals.
- Workshops and tutorials at conferences.

Collaborate

- Work with us to make your department accessible
- Refer students with disabilities in your departments to us for mentoring, internships & other complimentary support
- Contribute questions, promising practices to Knowledge Base

Activity

- Review the Department Accessibility Checklist
  - How is your department doing?
  - What should be added?
  - What should be reworded?

Thank You

www.washington.edu/accesscomputing