Calculus Section 9.8 Radius and Interval of Convergence
-Understand the definition of a power series
-Find the radius and interval of convergence of a power series

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Approximating the value of a function is one of the main uses of power series. However, not all power series are created equally. Some may give you good approximations for any value of x while others may only give good approximations at or near the center. The **radius of convergence** for a power series tell you how far away from the center you can be and still find a good approximation.

**Convergence of a Power Series**For a power series centered at c, precisely one of the following is true:
1) The radius of convergence is R = 0. The series converges only at c.
2) The radius of convergence is R > 0 such that the series converges absolutely for |x – c| < R, and diverges for |x – c| > R.
3) The radius of convergence is infinity. The series converges absolutely for all x.

In the 2nd scenario where R = finite number, the interval may have open or closed endpoints. Use any of the convergence tests from earlier in the chapter to determine whether an endpoint should be included.

\*We find the radius of convergence by using the Ratio Test.

**Example) Find the Radius and Interval of Convergence**

$$\sum\_{n=0}^{\infty }\frac{(-1)^{n}x^{2n+1}}{(2n+1)!}$$

$$\sum\_{n=0}^{\infty }n!x^{n}$$

1) 2)

3) 4)

$$\sum\_{n=0}^{\infty }\frac{(x-3)^{n+1}}{(n+1)4^{n+1}}$$

$$\sum\_{n=0}^{\infty }\frac{(-1)^{n+1}(x-2)^{n}}{n2^{n}}$$