To demonstrate the effectiveness of the SNN algorithms and to analyze the performance of the SNN networks, Benchmark functions were selected from the standard dataset "Benchmarks" for regression, including “ackley”, “adjiman”, “bird” and so on, as shown as follow.

Website:

https://github.com/mazhar-ansari-ardeh/Benchmarks

http://benchmarkfcns.xyz

References

[1] M.A. Ardeh, Benchmark s from https://github.com/mazhar-ansari-ardeh/Benchmarks, 2016.

Benchmarks:

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ackley :

$$f(\mathbf{x}) = f(x_1,\dots,x_n) = -a.exp(-b\sqrt{\frac{1}{n}\sum_{i=1}^{n} x_i^2}) - exp(\frac{1}{d}\sum_{i=1}^{n} cos(cx_i)) + a + exp(1)$$

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ackleyn2 :

$$f(x,y) = -200e^{-0.2\sqrt{x^2+y^2}}$$

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ackleyn3 :

$$f(x,y) = -200e^{-0.2\sqrt{x^2+y^2}} + 5e^{cos(3x)+sin(3y)}$$

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adjiman :

$$f(x,y) = cos(x)sin(y) - \frac{x}{y^2+1}$$

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alpinen1 :

$$f(\mathbf{x}) = f(x_1, \ldots, x_n) = \sum_{i=1}^{n} |x_i sin(x_i) + 0.1x_i|$$

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alpinen2 :

$$f(\mathbf{x}) = f(x_1, \ldots, x_n) = \prod_{i=1}^{n} \sqrt{x_i} sin(x_i)$$

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bartelsconn :

$$f(x, y) = |x^2 + y^2 + xy| + |sin(x)| + |cos(y)|$$

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beale :

$$f(x, y) = (1.5 - x + xy)^2 + (2.25 - x + xy^2)^2 + (2.625 - x + xy^3)^2$$

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bird :

$$f(x, y) = sin(x)e^{(1-cos(y))^2} + cos(y)e^{(1-sin(x))^2} + (x - y)^2$$

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bohachevskyn1 :

$$f(x, y) = x^2 + 2y^2 - 0.3cos(3\pi x) - 0.4cos(4\pi y) + 0.7$$

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bohachevskyn2 :

$$f(x, y) = x^2 + 2y^2 - (0.3cos(3\pi x))(0.4cos(4\pi y)) + 0.3$$

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booth :

$$f(x, y) = (x + 2y - 7)^2 + (2x + y - 5)^2$$

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brent :

$$f(x,y)=(x+10)^2+(y+10)^2+e^{-x^2-y^2}$$

brown :

$$f(\mathbf{x})=\sum_{i=1}^{n-1}(x_i^2)^{(x_{i+1}^2+1)}+(x_{i+1}^2)^{(x_i^2+1)}$$

bukinn6 :

$$f(x,y)=100\sqrt{|y-0.01x^2|}+0.01|x+10|$$

crossintray :

$$f(x,y)=-0.0001(|sin(x)sin(y)exp(|100-\frac{\sqrt{x^2+y^2}}{\pi}|)|+1)^{0.1}$$

deckkersaarts :

$$f(x,y)=10^5x^2+y^2-(x^2+y^2)^2+10^{-5}(x^2+y^2)^4$$

dropwave :

$$f(x,y)=-fraccos(1+12\sqrt{x^2+y^2})(0.5(x^2+y^2)+2)$$

easom :

$$f(x,y)=?cos(x_1)cos(x_2)exp(?(x?\pi)^2?(y?\pi)^2)$$

eggcrate :

$$f(x,y)=x^2+y^2+25(sin^2(x)+sin^2(y))$$

exponential :

$$f(\mathbf{x}) = f(x_1, \dots, x_n) = -exp(-0.5\sum_{i=1}^{n} x_i^2)$$

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goldsteinprice ：

$$f(x,y) = [1+(x+y+1)^2(19?14x+3x^2?14y+6xy+3y^2)][30+(2x?3y)^2(18?32x+12x^2+4y?36xy+27y$$

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gramacylacy ：

$$f(x) = \frac{sin(10\pi x)}{2x} + (x-1)^4$$

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griewank ：

$$f(\mathbf{x}) = f(x_1, \dots, x_n) = 1 + \sum_{i=1}^{n} \frac{x_i^2}{4000} - \prod_{i=1}^{n} cos(\frac{x_i}{\sqrt{i}})$$

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happycat ：

$$f(\mathbf{x}) = \left[\left(\|\mathbf{x}\|^2 - n\right)^2\right]^\alpha + \frac{1}{n}\left(\frac{1}{2}\|\mathbf{x}\|^2 + \sum_{i=1}^{n} x_i\right) + \frac{1}{2}$$

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himmelblau ：

$$f(x,y) = (x^2 + y - 11)^2 + (x + y^2 - 7)^2$$

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holdertable ：

$$f(x,y) = -|sin(x)cos(y)exp(|1 - \frac{\sqrt{x^2+y^2}}{\pi}|)|$$

keane ：

$$f(x,y) = -\frac{\sin^2(x-y)\sin^2(x+y)}{\sqrt{x^2+y^2}}$$

leon :

$$f(x,y)=100(y?x^3)^2+(1?x)^2$$

levin13 :

$$f(x,y)=sin^2(3\pi x)+(x-1)^2(1+sin^2(3\pi y))+(y-1)^2(1+sin^2(2\pi y))$$

matyas :

$$f(x,y)=0.26(x^2+y^2)-0.48xy$$

mccormick :

$$f(x,y)=sin(x+y)+(x-y)^2-1.5x+2.5y+1$$

periodic :

$$f(\mathbf{x})=f(x_1,...,x_n)=1+\sum_{i=1}^{n}sin^2(x_i)-0.1e^{(\sum_{i=1}^{n}x_i^2)}$$

powellsum :

$$f(\mathbf{x})=f(x_1,...,x_n)=\sum_{i=1}^{n}|x_i|^{i+1}$$

qing :

$$f(\mathbf{x}) = f(x_1,...,x_n) = \sum_{i=1}^{n}(x^2 - i)^2$$

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quartic :

$$f(\mathbf{x}) = f(x_1,...,x_n) = \sum_{i=1}^{n} ix_i^4 + \text{random}[0,1)$$

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rastrigin :

$$f(x,y) = 10n + \sum_{i=1}^{n}(x_i^2 - 10cos(2\pi x_i))$$

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ridge :

$$f(\mathbf{x}) = x_1 + d\left(\sum_{i=2}^{n} x_i^2\right)^{\alpha}$$

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rosenbrock :

(Tex translation failed)

f(x, y)=\sum_{i=1}^{n}[b (x_{i+1} - x_i^2)^ 2 + (a - x_i)^2]

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salomon :

$$f(\mathbf{x}) = f(x_1,...,x_n) = 1 - cos(2\pi\sqrt{\sum_{i=1}^{D} x_i^2}) + 0.1\sqrt{\sum_{i=1}^{D} x_i^2}$$

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schaffern1 :

$$f(x,y)=0.5+\frac{sin^2(x^2+y^2)^2-0.5}{1+0.001(x^2+y^2)^2}$$

$$f(x,y)=0.5+(\sin^2(x^2+y^2)^2-0.5)/(1+0.001(x^2+y^2))^2$$

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schaffern2 :

$$f(x,y)=0.5+\frac{sin^2(x^2-y^2)-0.5}{(1+0.001(x^2+y^2))^2}$$

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schaffern3 :

$$f(x,y)=0.5+\frac{sin(cos(|x^2-y^2|))-0.5}{(1+0.001(x^2+y^2))^2}$$

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schaffern4 :

$$f(x,y)=0.5+\frac{cos(sin(|x^2-y^2|))-0.5}{(1+0.001(x^2+y^2))^2}$$

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schwefel220 :

$$f(\mathbf{x})=f(x_1,\ldots,x_n)=\sum_{i=1}^{n}|x_i|$$

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schwefel221 :

$$f(\mathbf{x})=f(x_1,\ldots,x_n)=\max_{i=1,\ldots,n}|x_i|$$

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schwefel222 :

$$f(\mathbf{x}) = f(x_1,...,x_n) = \sum_{i=1}^{n} |x_i| + \prod_{i=1}^{n} |x_i|$$

schwefel223 ：

$$f(\mathbf{x}) = f(x_1,...,x_n) = \sum_{i=1}^{n} x_i^{10}$$

schwefel ：

$$f(\mathbf{x}) = f(x_1,...,x_n) = \prod_{i=1}^{n} \left(\sum_{j=1}^{5} cos((j+1)x_i + j) \right)$$

Matlab: $f(\mathbf{x}) = f(x_1,...,x_n) = 418.9829n - \sum_{i=1}^{n} x_i \sin(\sqrt{|x_i|})$

shubert3 ：

$$f(\mathbf{x}) = f(x_1,...,x_n) = \sum_{i=1}^{n} \sum_{j=1}^{5} j sin((j+1)x_i + j)$$

shubert4 ：

$$f(\mathbf{x}) = f(x_1,...,x_n) = \sum_{i=1}^{n} \sum_{j=1}^{5} j cos((j+1)x_i + j)$$

shubert ：

$$f(\mathbf{x}) = f(x_1,...,x_n) = \prod_{i=1}^{n} \left(\sum_{j=1}^{5} cos((j+1)x_i + j) \right)$$

sphere ：

$$f(\mathbf{x}) = f(x_1, x_2, \ldots, x_n) = \sum_{i=1}^{n} x_i^2$$

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styblinskitank :

$$f(\mathbf{x}) = f(x_1, \ldots, x_n) = \frac{1}{2}\sum_{i=1}^{n}(x_i^4 - 16x_i^2 + 5x_i)$$

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sumsquares :

$$f(\mathbf{x}) = f(x_1, \ldots, x_n) = \sum_{i=1}^{n} i x_i^2$$

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threehumpcamel :

$$f(x, y) = 2x^2 - 1.05x^4 + \frac{x^6}{6} + xy + y^2$$

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wolfe :

$$f(x, y, z) = \frac{4}{3}(x^2 + y^2 - xy)^{0.75} + z$$

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xinsheyangn1 :

$$f(\mathbf{x}) = f(x_1, \ldots, x_n) = \sum_{i=1}^{n} \epsilon_i \, | x_i |^i$$

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xinsheyangn2 :

$$f(\mathbf{x}) = f(x_1,\ldots,x_n) = (\sum_{i=1}^{n} |x_i|) exp(-\sum_{i=1}^{n} sin(x_i^2))$$

xinsheyangn3 :

$$f(\mathbf{x}) = f(x_1,\ldots,x_n) = exp(-\sum_{i=1}^{n} (x_i / \beta)^{2m}) - 2exp(-\sum_{i=1}^{n} x_i^2) \prod_{i=1}^{n} cos^2(x_i)$$

xinsheyangn4 :

$$f(\mathbf{x}) = f(x_1,\ldots,x_n) = \left(\sum_{i=1}^{n} sin^2(x_i) - e^{-\sum_{i=1}^{n} x_i^2} \right) e^{-\sum_{i=1}^{n} sin^2 \sqrt{|x_i|}}$$

zakharov :

$$\sum_{i=1}^{n} x_i^2 + (\sum_{i=1}^{n} 0.5 i x_i)^2 + (\sum_{i=1}^{n} 0.5 i x_i)^4$$