CLAIMS

What is claimed is:

1. A method for determining a route, the method comprising:

obtaining input data from a user, the input data comprising an indication of an origin and a destination for a trip in a road network;

obtaining real-time traffic data from a plurality of probe vehicles spatially distributed across the road network;

obtaining a past traveled route from at least one of the plurality of probe vehicles, each probe vehicle having a respective past traveled route, the past traveled route indicating a sequence of road segments traveled in the trip;

determining, using a first neural network, a representation of the past traveled route;

determining, using a second neural network, a representation of the real-time traffic data;

determining, using an adjoint generative process, a representation of the destination;

generating a second latent variable based on a second posterior distribution conditioned on spatial coordinates of the destination, wherein determining, using the adjoint generative process, the representation of the destination comprises:

simultaneously determining, based on the second latent variable, a plurality of destination proxies in the road network, and

allocating the trip to a selected destination proxy of the plurality of destination proxies, the selected destination proxy being the representation of the destination; and

determining a next road segment for the trip based on the representation of the past traveled route, the representation of the real-time traffic data, and the representation of the destination.

2. The method of claim 1, wherein the first neural network comprises one or more recurrent neural networks.

3. The method of claim 1, wherein the second neural network comprises a convolutional neural network and multi-layer perceptrons.

4. The method of any one of claims 1 to 3, wherein determining, using the second neural network, the representation of the real-time traffic data comprises:

providing the real-time traffic data as an input to the second neural network; and

generating a first latent variable as an output of the second neural network, the first latent variable being the representation of the real-time traffic data.

5. The method of claim 4, further comprising inferring, using a first variational auto-encoder, a first posterior distribution conditioned on the real-time traffic data.

6. The method of claim 5, wherein generating the first latent variable as the output of the second neural network comprises:

selecting a first random variable from the first posterior distribution conditioned on the real-time traffic data, the first random variable being the first latent variable.

~~7. The method of claim 6, wherein determining, using the adjoint generative process, the representation of the destination comprises:~~

~~simultaneously determining, based on a second latent variable, a plurality of destination proxies in the road network; and~~

~~allocating the trip to a selected destination proxy of the plurality of destination proxies, the selected destination proxy being the representation of the destination.~~

~~8. The method of claim 7, further comprising generating the second latent variable based on a second posterior distribution conditioned on spatial coordinates of the destination.~~

~~9~~7. The method of claim 5~~8~~, further comprising inferring, using a second variational auto-encoder, the second posterior distribution conditioned on the spatial coordinates of the destination.

~~10~~8. The method of claim 1~~8~~, wherein generating the second latent variable based on the second posterior distribution conditioned on the spatial coordinates of the destination comprises:

selecting a second random variable from the second posterior distribution conditioned on the spatial coordinates of the destination, the second random variable being the second latent variable.

~~11~~9. A system for determining a route, the system comprising:

a memory; and

at least one processor communicatively coupled to the memory and configured to perform operations comprising:

obtaining input data from a user, the input data comprising an indication of an origin and a destination for a trip in a road network;

obtaining real-time traffic data from a plurality of probe vehicles spatially distributed across the road network;

obtaining a past traveled route from at least one of the plurality of probe vehicles, each probe vehicle having a respective past traveled route, the past traveled route indicating a sequence of road segments traveled in the trip;

determining, using a first neural network, a representation of the past traveled route;

determining, using a second neural network, a representation of the real-time traffic data;

determining, using an adjoint generative process, a representation of the destination;

generating a second latent variable based on a second posterior distribution conditioned on spatial coordinates of the destination, wherein determining, using the adjoint generative process, the representation of the destination comprises:

simultaneously determining, based on the second latent variable, a plurality of destination proxies in the road network, and

allocating the trip to a selected destination proxy of the plurality of destination proxies, the selected destination proxy being the representation of the destination; and

determining a next road segment for the trip based on the representation of the past traveled route, the representation of the real-time traffic data, and the representation of the destination.

~~12~~10. The system of claim ~~11~~9, wherein the first neural network comprises one or more recurrent neural networks.

~~13~~11. The system of claim ~~11~~9, wherein the second neural network comprises a convolutional neural network and multi-layer perceptrons.

~~14~~12. The system of any one of claims ~~11~~ 9 to ~~13~~11, wherein determining, using the second neural network, the representation of the real-time traffic data comprises:

providing the real-time traffic data as an input to the second neural network; and

generating a first latent variable as an output of the second neural network, the first latent variable being the representation of the real-time traffic data.

~~15~~13. The system of claim ~~14~~12, the operations further comprising inferring, using a first variational auto-encoder, a first posterior distribution conditioned on the real-time traffic data.

~~16~~14. The system of claim ~~15~~13, wherein generating the first latent variable as the output of the second neural network comprises:

selecting a first random variable from the first posterior distribution conditioned on the real-time traffic data, the first random variable being the first latent variable.

~~17. The system of claim 16, wherein determining, using the adjoint generative process, the representation of the destination comprises:~~

~~simultaneously determining, based on a second latent variable, a plurality of destination proxies in the road network; and~~

~~allocating the trip to a selected destination proxy of the plurality of destination proxies, the selected destination proxy being the representation of the destination.~~

~~18. The system of claim 17, the operations further comprising generating the second latent variable based on a second posterior distribution conditioned on spatial coordinates of the destination.~~

~~19~~15. The system of claim ~~18~~13, the operations further comprising inferring, using a second variational auto-encoder, the second posterior distribution conditioned on the spatial coordinates of the destination.

~~20~~16. The system of claim ~~9~~18, wherein generating the second latent variable based on the second posterior distribution conditioned on the spatial coordinates of the destination comprises:

selecting a second random variable from the second posterior distribution conditioned on the spatial coordinates of the destination, the second random variable being the second latent variable.

~~21~~17. A non-transitory computer-readable medium comprising instructions that are operable, when executed by a data processing apparatus, to perform operations comprising:

obtaining input data from a user, the input data comprising an indication of an origin and a destination for a trip in a road network;

obtaining real-time traffic data from a plurality of probe vehicles spatially distributed across the road network;

obtaining a past traveled route from at least one of the plurality of probe vehicles, each probe vehicle having a respective past traveled route, the past traveled route indicating a sequence of road segments traveled in the trip;

determining, using a first neural network, a representation of the past traveled route;

determining, using a second neural network, a representation of the real-time traffic data;

determining, using an adjoint generative process, a representation of the destination;

generating a second latent variable based on a second posterior distribution conditioned on spatial coordinates of the destination, wherein determining, using the adjoint generative process, the representation of the destination comprises:

simultaneously determining, based on the second latent variable, a plurality of destination proxies in the road network, and

allocating the trip to a selected destination proxy of the plurality of destination proxies, the selected destination proxy being the representation of the destination; and

determining a next road segment for the trip based on the representation of the past traveled route, the representation of the real-time traffic data, and the representation of the destination.